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The effects of taxation on the financial behaviour of the firm

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THE EFFECTS OF TAXATION ON THE FINANCIAL BEHAVIOUR OF THE FIRM

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ABSTRACT

Taxation has been implied by econometric models in finance as being an important determinant of the financial behaviour of the firm, yet not many studies have attempted to provide a direct empirical evidence on such impact. The macro-economics studies have assumed that all the firms in the economy pay the standard corporation tax. However, in reality, many firms face a much lower effective corporate tax, and, sometimes, even do not pay tax at all.

The objective of this study is fourfold:

First, to evaluate the implications of the different allowances provided by the UK corporation tax system during the period 1972-1983 on the effective corporation tax rates using a sample of 109 domestic non-financial companies. The results are based on a computer model using publicly available data extracted from the Extat data bank.

Second, to assess the impact of this corporation tax system on the financing decisions of the firms in the sample. More specifically, the hypothesis that tax exhaustion makes debts a less attractive method of finance is tested.

Third, to analyse the effects of personal income taxation on dividend distribution. The decision on whether to distribute or to retain after tax profits is viewed as being a function of the marginal personal income tax rates of the firm's shareholders.

Fourth, to test for the effects of taxation on investment behaviour of

the sample of firms using both the neoclassical and the valuation models. The impact of the tax exhaustion position is also tested.

The research findings indicate that capital allowances and stock relief have contributed significantly to the low levels of the effective corporate taxes as paid by the firms in the sample. Although the magnitude of the importance of these two provisions has changed during the sample period, stock relief is found, on average, to be the most significant determinant of the high number of tax exhausted companies.

Tax exhaustion is found to be one of the determinant of the observed low levels of debt-capital ratios of the firms in the sample. If a company cannot take advantage of tax shields on interest payments, then the cost of debts is higher and a rise in the level of debts will only result in an increase in the bankruptcy costs, as measured by the required return on equity and/or debts. However, due, probably, to the adjustment costs firms are not changing substantially their debt-capital ratios from one period to another. Furthermore, because of the low levels of effective corporate tax rates and capital gains tax rates, the after tax return on equity is found to be higher than that on debts and, as a consequence, firms may have opted for equity rather than debts in financing their investment projects.

Firms seem to take into account the relative personal income tax position of their shareholders in deciding on their dividend policy. As opposed to the classical system of corporation tax, the imputation system encourages firms to distribute more of their earnings as dividends. On the other hand the possibility that the firm may not be able to recover the advanced corporation tax exerts a negative effect on the decision to distribute dividends. However, because of the major changes in the tax system, the cross-sectional results do not support always these findings.

In order to determine whether taxation exerts any impact on investment expenditure, a number of econometric specifications have been tested. The original neoclassical model do not seem to explain the investment behaviour of our sample of companies. Therefore, under the basic assumptions of this model we conclude that taxation does not have any influence on investment. Some econometric problems did not allow us to reach a direct conclusion on the impact of taxation on investment when some assumptions of the neoclassical model were relaxed. Nevertheless, tax exhaustion did not seem to affect investment. Although the valuation model provided much better results than the neoclassical, it was found that the relatively good performance of the tax adjusted Q is due to the ratio of market value to capital stock rather than to the tax component.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The modern financial theory has argued for a significant impact of taxation on the behaviour of the firm. In particular, some models have been developed, in which it was found that it is only in the absence of taxation that the firm is indifferent as to the appropriate methods of finance , dividend policy and investment decisions. Therefore, we would expect that the introduction of taxation is likely to have significant impact on the behaviour of the firm. Yet, there is not sufficient empirical evidence on such effects.

As far as the financing methods are concerned, corporation tax discriminates between debts, retained earnings and new issues. Since interests are tax deductible, firms are expected to use the highest level of debts, as their market value would increase by an amount equal to the tax shield. However, the possibility of tax exhaustion and bankruptcy costs may reduce the tax advantages of debts. Moreover, if personal income tax rates of shareholders and bondholders are taken into account the after tax return to shareholder may be higher than that of bondholder (because the income of the former is taxed partly at personal income tax rate and partly at capital gains tax rate). This possibility may reduce the advantages offered by corporation tax to debt finance.

Firms would also be indifferent between distributing dividends or retaining earnings if the corporation tax system does not discriminate against dividends. Since shareholders are the owners of the company, corporation tax should, according to the theory, be based on the marginal income tax rate of shareholders. In many systems, however, dividends are taxed twice, at corporation tax rate and then at personal income tax rate. Firms are thus, inclined to reduce their dividend pay-out ratios to maximise the after tax return to shareholders through capital gains which, because of the allowances and deferment, are taxed at much lower effective capital gains tax rate than dividends. Therefore, because of the relative tax treatment of dividends and retained profits, firms are expected to reduce their dividend payments and to finance their investment projects with retained earnings in order to reduce the overall tax bill.

Another major distortion of the corporation tax on firm's behaviour is through its effects on investment expenditure. Corporation tax rate may increase the cost of capital of the firm, thus making some projects not profitable when discounted at the after tax rate of return. In order to stimulate capital growth some corporation tax systems allow firms to deduct a proportion of the total cost of their investment from taxable profits or, alternatively, provide some favourable treatment of depreciation of assets. However, in order to take advantage of these allowances, firms should have positive taxable profits against which claims may be made. If this is not the case, then a reduction in investment may be due to tax exhaustion.

Although the theory predicts the above likely distortion effects of taxation, very little empirical evidence is available. Previous studies have carried such tests using aggregate data. They have, however, resulted in a numerous intellectual disputes and disagreement about the extent to which corporate tax affects company's decisions. Tax incentives are, in general, considered to encourage investment expenditures but there was a lack of consensus amongst economists about the measurement and the incidence of such effects. Furthermore, since at the aggregate level, all firms are assumed to face the same standard rate of corporation tax, such measures, even if they are correct are likely to be biased, as they ignore the fact that the effective corporation tax applicable to each individual company is significantly different from the standard rate. Similarly, the cost of capital, depreciation rate, price of capital, gearing ratio and dividend policy are all situation specific characteristics of each firm and may not be treated as being the same.

Therefore, there is a need to undertake such analysis using company data to investigate the extent to which corporation tax may create some distortion in the firm's financing decision, dividend policy, and investment behaviour.

1. The Objective of the Study

Taxation is, in theory, an important factor the firms have to consider in their financial policy as it reduces the cost of debt finance and, as a consequence, the cost of financing a particular project. It also reduces the cost of acquiring assets through capital allowances. Using aggregate data, a number of econometric studies have found strong influence of taxation on the financial behaviour of all the firms. However, such analysis is not undertaken at firm level. The objective of this study is, thus, to provide a direct evidence on the effects of taxation on the main financial decisions of a sample of individual companies. The general aim of this research is fourfold :

First, to analyse the different components of the corporation tax system that prevailed during the sample period 1972-1983 in the UK and to evaluate the implications of the different allowances on the effective corporation tax rates of a sample of domestic non-financial firms. The results are based on computer model using company accounts.

Second, to assess the impact of this corporation tax system on the financing decision of the firm. More specifically, the hypothesis that tax exhaustion makes debts a less attractive method of finance is tested.

Third, to analyse the effects of personal income tax of shareholders and corporate tax on dividend. The decision on whether to distribute or to retain after tax profits is viewed as being a function of the marginal personal income tax rates of shareholders and the ability of the firm to recover the advanced corporation tax.

Fourth, to test for the impact of taxation on investment behaviour of a sample of firms using both the neoclassical and the valuation models. Moreover, the impact of tax exhaustion position is also analysed through the accelerator model.

A sample of domestic non-financial firms is selected from the Extat data bank to undertake such analysis, over the period 1972 through to 1983.

2. Limitations of the study

A number of limitations may be identified in this empirical work :

1) There is no attempt to supplement this empirical investigations by interviews or questionnaires;

2) No attempt is made to evaluate time series observations for each

individual company because of the relatively short time period of data available;

3) This analysis does not deal with other tax system apart from the one analysed here.

4) Data unavailability has been one of the major problems found during the process of this research. Accounting data was, for most of the cases, not suitable for this analysis. It was, therefore, necessary to adjust this data and to set a number of assumptions relating to the activities of the firm, nature of capital stock and to the composition of each firm's shareholders. This has also limited the sample period and the sample size used in this study.

3. Overview of the Study

Chapter 2 of the thesis deals with the theoretical difficulties involved in giving some reasons to the existence of corporation tax, together with the problems of defining the basis for the tax rate. The underlying system is then analysed and the effective corporation tax rate is computed for each company. A static simulation exercise is undertaken to determine what would have been the effective corporation tax rate as well as the number of tax exhausted companies, if particular existing provision is not made available.

In chapter 3 the effects of taxation on the financing decision of the firm are tested. The after corporate and personal tax cost of debts is compared to that of equity. Moreover, it is hypothesized that the level of gearing ratio of the firm is determined by a combination of two factors : tax advantages of debts and the degree of risk the firm is in. However, if the company is tax exhausted, then the cost of debts will be higher as no tax shields are gained. The model used is formulated in such a way as it could provide a possible answer to the leverage puzzle in the sense that the *optimum* level of corporate debts would be a function of both bankruptcy risks, as measured by the required return by shareholders and bondholders/banks, and the tax position the firm is in.

Empirical evidence for the relationship between the dividend policy, personal income taxation of shareholders and corporation tax is provided in chapter 4. The theoretical review of the literature asserts that the higher the dividend tax discrimination variable the higher the dividend pay-out ratio. The tax discrimination variable measures the proportion of after tax dividends which an average shareholder would receive for each unit of profit distributed. Moreover, if the firm cannot recover the advanced corporation tax then it may refrain from supplying dividends. Current dividends are assumed to be linearly related to the earnings and to the lagged level of dividends.

Chapter 5 is devoted to the review of the existing literature on the effects of taxation on investment. Previous studies have analysed such effects from a public economics point of view by using aggregate data to test the above models. On the other hand, models that have been applied at company level do not generally specify the importance of taxation on investment. It is, therefore, necessary to review both approaches in order to formulate hypotheses to be tested.

Chapter 6 describes a model based on the neoclassical framework which provides the basis for analysing the impact of taxation on investment behaviour. The important issues drawn from the review of the literature are stated explicitly and the variables used to test the hypotheses are defined and estimated. The models are formulated in such a way as the effects of corporation tax may be analysed explicitly by relaxing the assumption of unitary elasticity between the different components of the desired capital stock. Moreover, the hypothesis that tax exhaustion exerts a negative influence on investment expenditure is tested using the accelerator model.

In chapter 7 an alternative model of investment behaviour is tested to determine whether corporation tax affects the investment rate. This specification attempts to explain investment expenditure through the ratio of the market value of the firm to its capital stock, adjusted for taxation. If investment is positively correlated to the valuation ratio, then an increase in capital allowances and/or a reduction in the corporation tax rate would lead to a rise in investment.

The final chapter presents the main conclusions derived from the previous analysis and specify directions for further research on the effects of taxation in the firm's behaviour.

CHAPTER II

ISSUES IN TAXING CORPORATIONS

In many countries taxes are intended to serve a number of functions. If the economy is in a stage of rapid and unsustained growth with inflationary consequences, the government, by increasing tax rates, may dampen the level of economic activity, because, when tax rates are increased both personal disposable income and firms' profits are reduced. As a consequence both demand and investment are reduced. On the other hand, by reducing taxes, government may provide both consumers and companies with greater purchasing power and therefore, increase the incentive for firms to invest.

As far as the corporation tax is concerned, there are two main elements that are involved : the corporate tax rate and capital allowances. Taken individually, they are conflicting in their objectives. While the former increases the cost of capital, thus discourages investment, the latter, on the hand, aims at stimulating capital expenditure. Furthermore, personal income taxation of investors depends partly on the dividends and financial decision of the firm. Therefore, the study of the effects of taxation on financial policy has to deal with all these elements individually and possibly find their combined effects. Before undertaking such an exercise, it is perhaps worth looking first at a number of issues that surround taxing corporations in general. This review may highlight the difficulties dealt with in the next chapters. The complication is in defining the aims of taxing firms as opposed to taxing directly the shareholders and on how to set up an appropriate corporation tax system to achieve efficiently the above objectives and in the same time reduce the efficiency loss.

The present chapter deals with a brief analysis of the different issues that arise from taxing corporations and describes the type of corporation tax system on which this study is based. It starts by providing some reasons behind taxing corporations, discusses the problems involved in determining the accounting profit and then the different systems of corporation tax that are advocated are compared. Section 3 presents the underlying tax system for this analysis by looking at the different tax provisions available during the period 1973-1983 using a sample of 109 firms. The effective corporation tax rates under different alternative policies are computed then compared to observe the impact of each provision.

1. Problems with Taxing Corporations :

The introduction of corporation tax which is levied on the profits of incorporated but not unincorporated businesses has resulted in a number of controversies. The issues first relate to why companies are taxed differently from their owners, and secondly to the definition of profits on which the corporation tax is based. These two issues are analysed in the following section.

1.1 Reasons for taxing corporations :

In general the main reason for taxing corporations arises from the fact that companies are considered to be separate entities from their shareholders.A common justification given for the introduction of corporate tax is that companies should pay for the privileges conveyed by corporate status. Incorporation implies a limited legal liability of the owners of the company and as a consequence shareholders are protected in the event of bankruptcy. This limited liability may create taxable capacity. However such privileges are somehow reduced by the obligation of companies to obey some rules laid down by company law. For instance dividends cannot be paid from capital so that shareholders are not allowed to withdraw their contribution to the firm otherwise creditors would not be compensated in the event of bankruptcy. Furthermore, the costs of these privileges are not easily measurable. Even if they are, one cannot say that they are proportionate to profits and thus suitably paid for by a tax on profits.

Another argument for separate tax on corporate income relates to the fact that corporations retain part of the profit in the business. If all profits are distributed as dividends then they could be taxed directly at shareholders personal income tax rates. However, since pay-out ratio is usually less than unity, retained earnings are likely to increase the market value of the firm, thus resulting in capital gains which are taxed at lower effective rates (because of the deferment and the allowances). Moreover, because shareholders are taxed at different rates, taxing companies at shareholders income tax rate would create a problem of horizontal equity between shareholders and would be in conflict with the *equity* criteria of the corporation tax system[1].

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1. The Green Paper on Corporation Tax (1982) defined six criteria against which a corporation tax system may be assessed :
   a) Equity : The possibility of charging a like amount of tax on those who enjoy a like amount of income;
   b) Certainty : Tax system should be set in such a way as the authorities know who is liable and that taxpayers are aware of their liability;
   c) Simplicity : This maxim refers to both the administrative work involved and the comprehension by the users;
   d) Cost of collection : it concerns the elimination of unnecessarily

An alternative explanation for taxing companies at a different rate is for the governments to regulate the affairs of companies. The corporation tax may encourage or discourage the retention of profits in the company, influence the amount of capital investment undertaken, may dictate dividend policy of the firm and may affect the allocation of real capital between equipment, structures, inventories and land.

There is no direct evidence for taxing corporations separately. Many systems are attempting to reduce the discrepancy between corporation tax and personal income tax. Although the tax system has the advantage of allowing firms to establish a corporate pension scheme at a much higher rate than self employed or partnership, the gains of such allowance may not compensate for the corporate tax payments. Furthermore, the imputation system tends to a certain extent, as will be seen below, towards integrating corporation tax and personal income tax.

There is, however, a debate on who bears the tax burden. Harberger (1962) and Shoven and Whalley (1972) using a general equilibrium model, found that the tax on corporations rests upon the owners of the firm. As a consequence, the return on capital is reduced and this has a negative effects on capital formation. On the other hand,

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administrative costs for the taxpayer and the tax collector;
e) Economic criteria : Tax system performs a number of economic objectives. In particular tax system should be constructed after taking into account its effects on income distribution, macro-economic stability and resource allocation;
f) International considerations : Most companies have international activities. In setting up a corporation tax these international elements should be taken into account.

Krzyzaniak and Musgrave (1963) hold the view that corporation tax is passed on to the consumers through a rise in prices or increases unemployment. In this study, however, we assume that the firm bears tax and leave aside the question of the shifting of the corporation tax.

1.2 Bases for the Corporate Income Tax :

The existing corporate tax systems are based on the profit of the company after deducting interest payments, depreciation and other expenses. There are however, a number of controversies that may distort such definition of income: the measurement of depreciation of fixed assets, the measurement of inventory profits and the treatment of capital gains and losses. These areas are important in deciding on the appropriate base for taxation of corporate income, because an over or underestimation of any of these elements will lead to the company being inappropriately taxed. The Green Paper on Corporation Tax (1982) found that on historical cost basis the effective rate amounts, on average (i.e. including loss making companies), to 25% but once allowances have been made for inflation (using SSAP16) this rate jumps to 65%. Thus, since the corporation tax is not a lump sum, but rather a percentage applied to taxable profits, some companies may be taxed at more than 100% of their real profits. Most corporate tax systems allow some important provisions for these elements in defining the corporate tax base. It is thus necessary to analyse each of these constituents further.

1.2.1 The depreciation of fixed assets : Depreciation is tax deductible because it is considered to be an expense in the process of production, such as labour cost. However, as opposed to the latter, the actual cost of using the equipment is very difficult to measure because such equipment could have been bought a long-time before and thus its book value is likely to be completely different from its replacement value. Therefore, the depreciation deducted for tax purposes is underestimated, and a company using such a method will end up paying more tax than otherwise.

There are a number of possibilities to compute the depreciation rate. Under the straight-line method an equal amount, being a fixed percentage of the original value of the capital, is written-off each year. The double declining balance method, on the other hand, allows double percentage rate of write-off each year but applies it to a diminishing balance. The first method assumes that the value of the equipment does not change substantially over time, while the latter hedges against inflation as a large part of the depreciation is deducted in the first years. In some cases the depreciation formula is computed on the basis of sum of the digits where a fraction of the expenditure which declines linearly over the lifetime is allowed[2]. Alternatively, the tax system may allow the whole or part of the value of the capital to be written off as they incur. This free depreciation system

2. The straight line depreciation is obtained by dividing the total cost of the asset less the estimated salvage value by its economic life. The double declining balance applies the double depreciation rate to the total cost of the asset in the first year. In the second year this rate is applied to the difference between the total cost and to the amount of depreciation of the first year (i.e. net cost of assets) and so on. Under the sum of years digits, the yearly depreciation allowance is determined by first calculating the sum of the years digits (1+2+3+....n with n being the economic life), dividing the number of remaining years by the sum of the years' digits and then by multiplying this fraction by the depreciation cost (total cost less salvage value) of the asset.

allows companies to write off the original costs as they wish, either by deducting the total cost immediately, or by deducting a certain proportion in the year of the purchase and then take advantage of the writing-down allowance in subsequent years. Although the motive behind such provision appears to be an incentive to increase investment, it may be seen as an approximation to inflation accounting because it reduces nominal profits.

Ideally, the depreciation should be computed on the basis of the replacement cost of the capital. In such a case the economic depreciation would reflect the actual cost of using the equipment. However, there are a number of difficulties in computing the replacement cost of capital and thus the economic depreciation, because there are no perfect markets for used assets. The above depreciation formulas are all based on a kind of rule of thumb. With the exception of the free depreciation, all the other methods may be less advantageous to the firm in cases where the economic depreciation is higher than the depreciation used for tax purposes (Atkinson and Stiglitz (1980), lecture 5). An alternative way of dealing with the problem has been put forward by Auerbach and Jorgenson (1980) whereby allowance is given a once and for all when capital expenditure is incurred. The sum allowed is equal to the present value of economic depreciation over the life of the asset. However, this first year capital recovery system may be difficult to apply as it may involve some controversies as to the appropriate real rate of interest to use and the rate of depreciation over time.

1.2.2 The valuation of stocks : Similar to the cost of using the equipment, the cost of sales also may lead to a mismeasurement of the corporate tax base. The value of the stock bought some time ago may not reflect the cost of buying it when it is about to be used. Thus computing taxable profit on the basis of previously bought stock may lead to an overestimation of the amount of tax paid.

There are two methods for evaluating the stocks : FIFO (First-In-First-Out) and LIFO (Last-In-First-Out). Under the former system, allowed in the U.K., the increase in the value of stock over the accounting period is counted as an element of taxable profit, irrespective of whether this increase is due to a rise in the price level or a volume increase. If a company uses the LIFO method, it has to use up its stocks in the reverse order in which it has bought them. In this case there will not be any inventory profit or loss if the volume of stock and the prices remain the same. However, in cases where there is an increase in the volume of inventories or a rise in the price of inventories the inflationary gains are taxed as current profits under historical cost accounting. The timing of the realisation of these gains depends on the accounting method used. FIFO allows these gains to appear fairly soon while LIFO may postpone them indefinitely. There are some provisions, such as stock relief, which allow companies to deduct from taxable income a certain proportion of the inflation effect against tax.

1.2.3 Net monetary assets and liabilities : In order to adjust profits for inflationary effects, companies have to take account of the changes in the real value of net monetary assets and liabilities. The reason for adjusting profits for these elements is that real capital gains may be made by firms which are net debtors and real capital losses by those that are net creditors even if nominal values of assets and liabilities remain unchanged. Although the idea behind this adjustment is simple, its application may create some complications because then even personal income tax has to be indexed[3]. The inflation on liabilities is however reduced through the relief for the whole of nominal interests payments.

2. Corporation Tax Systems :

There are a number of different ways of classifying systems of corporate tax. If one is interested chiefly on the effects of taxation on the incentives to invest, then the convenient way of categorising corporation tax systems is by computing the minimum pre-tax rate of return necessary to induce the owners of the firm to invest. King and Fullerton (1984) based their classification on the tax wedge, defined as the difference between the pre-tax real rate of return on a marginal investment project and the post-tax real rate of return to the saver who supplied the finance. This approach calls for a deep analysis of each tax system. It is very complicated as it is based on a number of assumptions namely, the ways in which the project is financed, the identity and the tax bracket of each supplier of finance, the level of inflation rate, the marginal cost of capital and the type of assets.

An alternative classification is to take the view that corporation tax

3. Since 1982 capital gains are indexed by allowing the acquisition cost of a share to be adjusted by the increase in the retail price index that occurred after the asset has been held for one year. However, neither dividends nor interest income on debts are taxed on an indexed basis.

systems are different mainly in their treatment of the taxation on dividends as compared to the taxation of the undistributed profits. Under this method, the only variables that are compared are the corporation tax rate and the tax discrimination variable, θ, defined as the opportunity cost of retained earnings in terms of dividends foregone. The former tax variable is the tax levied on the profits of the company, while the latter attempts to find whether dividends are taxed more heavily than retentions, thus creating a distortion effects on the methods of finance.

The simplest corporation tax system is perhaps the classical system where the tax liability of the firms is independent of the shareholders' personal income tax liability. This practice, first introduced when corporation tax was advocated in 1904 in the US, stems from the fact that companies are seen as being different institutions from their shareholders. Under this system the firm pays a flat rate of corporation tax on all its taxable profits and shareholders, in turn, are liable to personal income tax on their receipts of dividends. Dividends are thus taxed twice as shareholders are not allowed any credit for the tax paid by the firm.

In cases where the corporation tax rate is equal to the marginal shareholders' personal income tax rate and the tax discrimination variable is equal to unity, the corporation tax system is integrated with the personal income tax system and the amount of tax corporations will have to bear will be solely dependent on the taxation of its shareholders. One way of implementing this system is by imputing undistributed profits to shareholders in proportion of their share in total equity capital, and then tax dividends and the imputed dividends incomes at the appropriate personal marginal rate (Carter Commission (1966)). Under this system there is no tax discrimination between retentions and distributions or between incorporated or unincorporated businesses, nor is debt finance treated differently from equity finance. However this system may not be practically implemented because of the problems that may arise in cases where the company makes a loss, where some shareholders hold shares for periods less than the relevant accounting period, where profits fluctuate from year to year and where firms operate in international markets.

Under the imputation system the tax discrimination variable is equal to, $\theta = \frac{(1-m)}{(1-s)}$ where s is the imputation rate while m is the marginal personal income tax rate. The imputation system attempts to reduce the double taxation of dividends by allowing a proportion equal to the standard rate of income tax, of the tax on dividends to be deducted at company level. This advance corporation tax is then deducted from the total corporation tax to obtain the mainstream corporation tax. This system however, does not, as the previous one, eliminate completely the discrimination against dividends, because not all shareholders are taxed at standard rate of corporation tax.

A two rate system is an alternative way of reducing the double taxation of dividends. It aims at taxing distributed profits at a lower rate than undistributed profits. Under this system the total tax liability includes a rate of corporation tax on undistributed profits, a different rate on corporation tax on distributed profits and the shareholders' rate on income tax on dividends. Shareholders can set both the withholding tax and the tax credit against their personal tax liability. This system does not discriminate between dividends and interests. However, it makes distributed profits subject to lower tax burden than retained profits if all shareholders are basic tax payers. Furthermore, if a company is tax exhausted then shareholders will be given a tax credit for tax which the firm has not actually paid. Also, if the company is wholly owned by tax exempt institutions, then the tax revenue would be zero if all the profit is distributed (which will be the case in order to maximise shareholders' wealth). Other problems with this system relate to international considerations and administrative costs (see Green Paper on Corporation Tax (1982) p.42 for these issues).

The corporation tax and the tax discrimination variable, θ, can be combined to measure the overall effects of a particular tax system. King (1977) defined the ACID (Attempted Corporate Integration of Dividends) test statistics as the ratio of the maximum net dividends that the shareholder could receive out of one unit of pre-tax profits to the maximum net dividends that would be received if the business were unincorporated. The aim of this test is to measure the extent to which the corporate tax and the personal income tax are integrated. If this ratio is unity then corporate tax system does not impose any extra tax on dividends over or above the level of personal taxation. This is achieved when the corporation tax is zero in the classical system or when the corporation tax is equal to the imputation rate in the imputation system[4]

The above comparison is based on two tax variables that must satisfy some conditions. It is necessary for the corporation tax rate to be non-negative because if it is then it becomes a subsidy. It is also important not to be confiscatory otherwise no dividends will be distributed. The other condition is for the tax discrimination variable, θ not to be negative and to be able to compare it to the personal income tax rate, it has to be less or equal to the shareholders' rate of income tax.

While the last condition may be satisfied in this analysis, the first ones are difficult to apply, because many companies have negative effective tax rates as a result of capital allowances, stock relief and other deductions. This analysis becomes more complicated when capital gains are accounted for. King argued that capital gains tax rates are not incorporated in the above analysis because this tax is charged only when gains are realised and also gains in a particular year cannot be directly identified with retained profits of that year. However, this depends on the assumption as to the marginal increase in the market value of the firm for a unit increase in the retained earnings (Tobin q). Neglecting these facts may lead to misleading comparison between different systems.

A system that may avoid the inflationary problems, dealt with in the

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4. The ratio is computed as : $ACID = \theta\frac{(1-\tau)}{(1-m)}$ If $\theta = 1 - m$ then ACID = 1 - τ while if $\theta = \frac{(1-m)}{(1-s)}$ then $ACID = \frac{(1-\tau)}{(1-s)}$ In the U.K., for instance, at present when the corporation tax is 35% and the imputation rate is 29% the ACID test is 0.915.

first section, and the distortion effects of taxation is based on the flow of funds rather than profits (Meade Committee (1978) chapter 12 and Edwards (1982a,b)). Under this system individuals will be taxed on the difference between their receipts during the tax year (such as salaries, dividends, sales of shares) and their savings. Similarly, firms are taxed on their savings being the use of funds within the business (e.g. retentions and reinvestment of profits) and their expenses. There are two related approaches which can be followed to implement this system. Companies may be taxed on the difference between total cash inflows from the sale of goods and services and total cash outflows on the purchase of goods and services, without any distinction between services and capital transactions but no financial transaction. As a consequence, all expenditures on capital assets would be deductible in the year they are made but no interest payments would be deductible and no tax will be due on interest received.

Alternatively, companies may be taxed on net financial outflows being the net dividend paid out plus the net acquisitions of shares in other companies less net inflows of funds from shareholders. As long as funds are saved in the business, they would not be taxed. Thus retained earnings are not taxed, and the corporate tax will be based on the net take out from the corporate sector rather than on profits.

The advantage of this system is that depreciation and inflation would not distort the taxation of companies. There would be no wedge between pre- and post-tax returns at the margin, no tax discrimination between retention and dividends and no double deduction through allowing both investment and interest deductibility. However, if the first approach is adopted, many financial companies will have a negative tax base with interest receipts higher than interest payments. Therefore there will be a shift in the distribution of the corporate tax burden. Under the second proposal there is a need for a higher tax rate (e.g. estimated at 200% by Green Paper 1982) to raise the same amount of tax revenue. Thus, companies with high retentions would be highly favoured. Moreover, the distribution of tax between sectors would vary from year to year depending on their distribution or their cash flow. Furthermore, international considerations may make this system not applicable.

3. Computation of the Effective Corporation Tax Rate :

The computation of the effective corporation tax rate may be just an approximation of the actual tax payment as calculated by the tax officer because there are a number of possible ways of taking account of the allowances and different accounting methods. Such complications arise in the treatment of the Advanced Corporation Tax (ACT) which in fact is a personal income tax liability deducted at source and in the timing differences between accruals and payments of taxation. Companies may be different in their treatment of deferred taxation. In the case of depreciation allowances some companies may opt for the whole 100% initial allowance in the first year thus do not claim any writing-down allowance in subsequent years. Furthermore, a firm may decide to claim the whole of the recoverable ACT whenever possible, while others would rather spread the claim through a number of years. Nevertheless, an attempt is made here to estimate the effective corporation tax rates by using the reported accounting data coupled with the estimation of the different allowances for each year and for each company. This exercise is necessary to evaluate the effects of each allowance and to determine the extent of tax exhaustion of each firm in the sample.

3.1 Characteristics of the UK corporation tax :

The structure of the corporation tax system that prevailed during the sample period may be represented in the following graph.

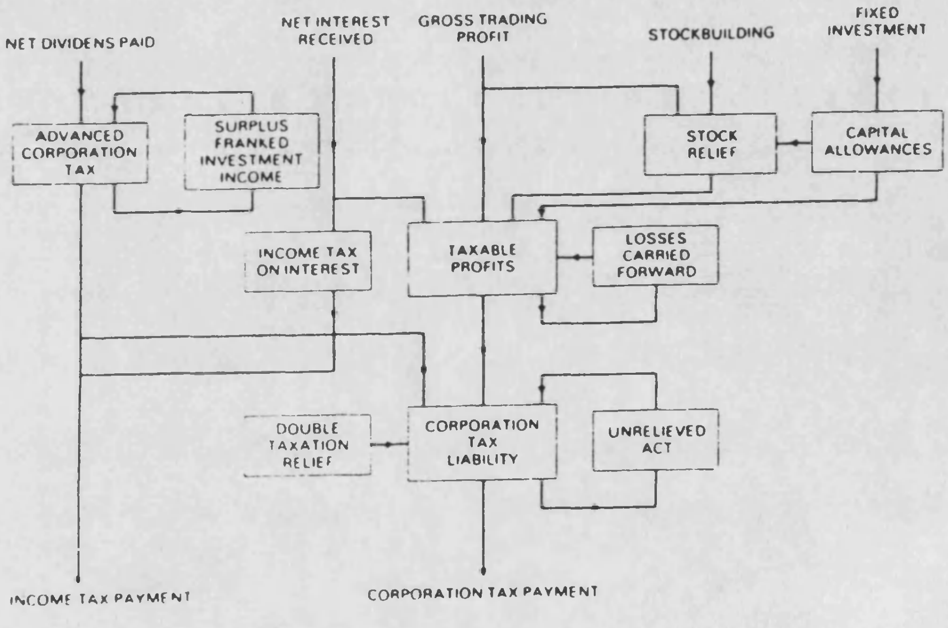

Figure 1. Simplified representation of the corporate tax model
Source : Mayer (1982).

The central point in computing the effective corporation tax rate is the computation of the taxable profit. This is different from the published "profit before tax" because the latter does not take account of the allowances and includes such expenses as entertainment of UK customers, political donations and gifts which do not qualify as expenses for tax purposes. The objective of the corporation tax model[5] is to use publicly available accounting information together with an approximation of the principal allowances which arise from capital expenditure and stock relief to arrive at the Inland Revenue's assessment of firm's taxable profits. Then applying the appropriate corporation tax rate adjusted for small companies, the tax liability may be obtained. By dividing this tax amount by profit before tax, the effective corporate tax rate will be obtained.

This model is applied to each of the 109 non-financial domestic UK public companies during the 1972-1983 period. This sample of firms is arrived at after checking all the companies in the Extat data bank for these that have not merged or acquired other major companies, for those that operate only in the domestic market and for those that the maximum data is available during the sample period. It is assumed that if a company operates in an international market its financial policy may be substantially influenced by the tax system in these other countries and, as a consequence, it may be difficult to isolate the possible impact of the UK tax system. The necessary condition for including a particular company in our sample is for the Double Taxation Relief (DTR) to be zero for any year in the sample period, and for the number of employees abroad to be less than 1 per cent of the total work force[6]. Using publicly available data, this model calculates, for each company, taxable profit, mainstream tax liability,

5. I am very grateful to my supervisor, Dr. M. Levis for allowing me to use the original tax model.
6. The DTR limitation is not enough for our selection because it depends on any agreements between the UK and the other country. One per cent is, however, an arbitrary figure, but it is supposed to represent agents of the firm abroad for selling not producing the output.

advance corporation tax, capital allowances, pooled of depreciation allowances and the stock relief.

Capital allowances are computed on the basis of the reported net investment expenditure during the period (i.e. additions less disposals). There are two main types of investment expenditure : investment in plant and machinery and investment in buildings. Both are treated differently as far as allowances are concerned.

During the sample period plant and machinery capital expenditures have benefited from two incentives, being the initial allowance and the writing-down allowance. The former is a tax deduction on a certain percentage of the initial cost of the asset. The latter on the other hand, is computed on the difference between the original cost of the asset and the initial allowance. Since 1972 the initial allowance has been set equal to 100% of the total cost of the asset. However, companies may take the option of reducing the amount of the first year allowance claimed to any other lower percentage and claim in subsequent years a writing down allowance of 25% on the written down value. This practice allows firms to benefit from taxation of profits at reduced rates over a number of years, but this advantage may be weighed against the opportunity cost of the tax that could have been avoided in the first year. If the company decides not to take all or part of the first year allowance to which it is entitled and if more than one item of plant and machinery has been purchased, then that part of the expenditure on which no initial allowance is taken goes into a "pool" of unallowed expenditure qualifying for writing-down allowance, rather than carried over to the following year. If an asset is sold then a balancing charge is applied to the difference between the disposal value and the value of the qualifying expenditure. This balancing charge reduces the firm's initial allowance by the value of the sale over the amount carried forward in the pool. This would come to the same results as if the disposals are deducted from the purchases and set the net investment against the initial allowance.

Initial allowance for industrial buildings has been lower than that of plant and machinery (40% up to 1974, 50% until 1981 and 75% thereafter). Depreciation allowance of 4% is calculated on a straight line basis over the life of the asset assumed for tax purposes and computed net of initial allowances. Similar to the plant and machinery, investment in industrial buildings can be taken as net because when the building is sold, the proceeds less the cost, initial allowance and writing-down allowance will be subject to a balancing charge if there is a profit or to a balancing allowance if there is a loss.

Another major deduction for tax purposes is the stock relief. It was introduced in 1973 to lessen the effects of inflation on stock replacement. The increase in the value of stock less a certain proportion of the income for the period may be treated as an allowable expense. For the first 2 years, this proportion was set at 10% and the income is defined gross of capital allowances, while up to 1980 this proportion was increased to 15% and is calculated on income net of allowances. After 1980 the deduction is no longer on the increase in both price and volume of stock, but rather on condition that there is an increase in the All Stock Index over the period and that the value of the stock at the end of the preceding period of accounts exceeds some fixed sum. The All Stock Index is a monthly index which reflects the movements in the average price level of stocks held by companies[7]. The 1981 stock relief reform thus restricts relief to stock appreciation which is due only to price changes. On the other hand, if the value of stock has decreased then the firm is liable to a claw-back on its previous relief. For the period before 1979 the claw-back is limited to the lesser of the previous relief unrecovered and the fall in the value of stock. Thereafter, recoverable relief is restricted to six year period preceding the accounting year.

There are other deductions before arriving at the taxable profits. Net interest payments are not taxed. Capital gains are taxed at lower rate (different from capital gains tax rate for individuals), but capital losses are only carried forward to be set against future capital gains and not against current trading income. On the other hand, trading losses can be set against capital gains.

Franked investment income arises in cases where the company is a net recipient of dividends. They may be set against trading losses. The tax credit associated with net dividend receipts can be realised. The imputation system allows companies to deduct income tax at an imputation rate, equal to a standard rate of income tax, on gross dividends paid. The payments of the advanced corporation tax (ACT) are set against mainstream corporation tax, on the condition that the gross distribution that forms the basis of the ACT deduction

7. The formula for computing the stock relief is as follows:
$$\textit{Opening value of stock} - 2000 \textit{ Pounds} * \frac{SPI_t - SPI_{t-1}}{SPI_{t-1}}$$
Where SPI is the All Stock Price Index.

should not be more than the taxable profits against which they are being set, in any of the preceding years and current year. If this condition does not apply then the surplus ACT may be carried back and set against mainstream liabilities of any of the two preceding years as well as the current year, or alternatively, it can be carried forward and set against future profits. In cases where the company is receiving dividends from other UK companies it can set the income tax that is with dividend receipts against the amount due on its payments.

This brief review of the corporation tax system studied forms the basis for computing the effective corporation tax rates for each company and in each year during the sample period[8]. However, before presenting the results of the computation of the effective corporation tax under different assumptions, it is worth assessing the reliability of such calculation. One way of measuring this accuracy is by comparing the recorded against the computed corporation tax. Given the large number of firms in the sample comparing one observation against another is impossible. Instead recorded tax is regressed against the computed tax. Data is obtained from the Extat data bank. The recorded tax is the actual tax paid by the companies in the sample during the sample period. This is the difference between the profit before tax and the profit after tax. To obtain the computed tax we apply the effective corporation tax rates as obtained from the tax model, for each company and for each year in the sample period,

8. See Mayer and Morris (1982a) for the necessary equations to formulate the computer model.

to the profit before tax. In this way the computed effective tax paid by the company is obtained. The following coefficients are obtained from the regression:

TABLE 2.1. ACCURACY OF COMPUTED TAX

$$RecordedTax = \alpha + \beta ComputedTax$$

Coef	Pooled	73	74	75	76	77	78	79	80	81	82	83
α	293	73	188	139	351	258	443	468	129	261	47	292
	(5.8)	(.5)	(1.3)	(1.4)	(3.1)	(1.3)	(4.3)	(2.7)	(.8)	(1.3)	(0.2)	(1.3)
β	1.11	1.55	2.5	1.37	1.22	1.49	0.87	0.9	1.12	0.84	1.3	1.16
	(71.4)	(14.5)	(16)	(32)	(34)	(21)	(30)	(13)	(26)	(21)	(19)	(30)
R^2	.80	.67	.71	.91	.92	.81	.90	.60	.87	.81	.78	.89

The recorded tax liability is the actual tax liability as reported by the companies in the sample, i.e. difference between profit before tax and profit after tax. The computed tax liability is obtained by applying the effective corporation tax calculated from the tax model to the reported profit before tax.

The above table shows that the t statistics of the computed tax are highly significant in all the years. Moreover, the high coefficient of determination ($\bar{R}^2$) proves that, on average, about 80% of the observed tax liability is caught by the values obtained from the tax model. One can thus say that the estimates on which the remaining analysis is based on are consistent.

3.2 Cross-sectional distributions of corporation tax rates :

In this section we undertake a static analysis by assuming that any change in the corporation tax system would not affect the financial decision of the firms in the sample. This will allow us to estimate the importance of each tax deduction before the 1984 reform in the corporation tax system. This assumption is relaxed in the next chapters where the impact of taxation on the financial policy of the firm will be dealt with.

Two alternatives are followed to analyse the computed corporation tax rate as faced by the companies in the sample. In the first instance, the average effective tax is plotted to see the changes that have occurred during the sample period and also how distant the computed rates are from the statutory rates. This analysis is extented to simulate the alternative policies by asking what would happen to the effective corporate tax if particular deduction was not allowed. In such a way, the importance of each provision in the corporate tax system is determined. Another way of undertaking such analysis is by computing the number of companies that have negative taxable profit. The same simulation exercise to determine the importance of each provision in explaining the tax exhaustion situation, is followed. A subdivision of companies in the sample into different industries would not be of so much significance given the low number of companies (See Levis and Morgan (1985) for detailed analysis of the distribution of the tax amongst industries).

3.2.1 The effective corporate tax rate : Figure 2 records the average effective corporation tax rate (computed corporate tax liability over pre-tax profits which is trading profits *plus* other income *plus* investment income *minus* depreciation *minus* interest paid) of all the firms in the sample during 1973 through to 1983, under different assumptions, and the average statutory corporation tax rate, adjusted for small firms.

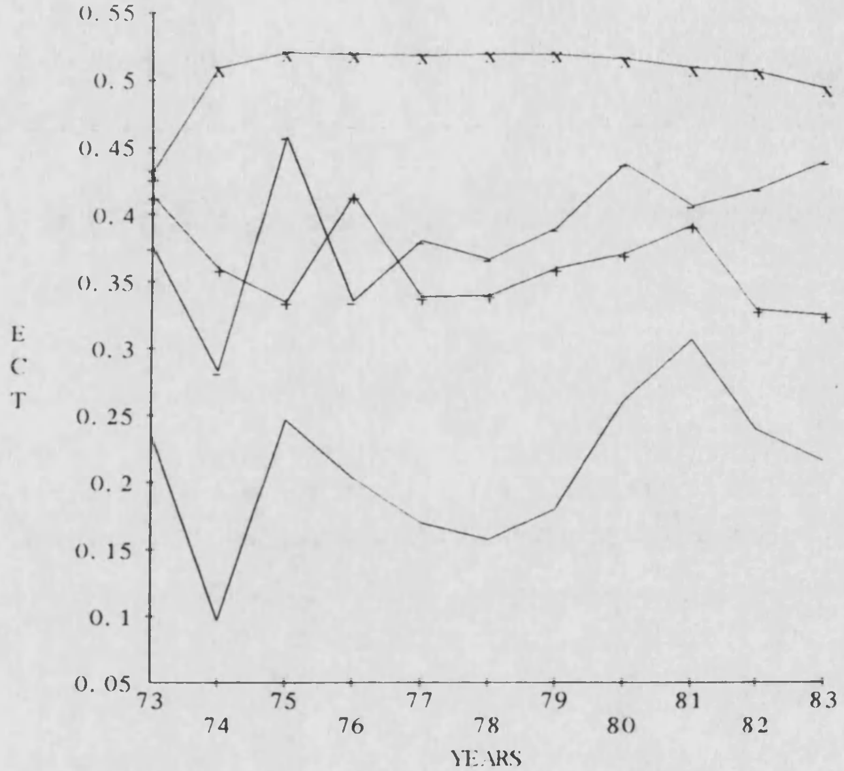

Figure 2. Impact of capital allowances and stock relief

Notes :

--x-- Standard rate of corporate tax (adjusted for small firms);

----- Effective Corporation Tax (ECT);

--+-- ECT without stock relief;

--_-- ECT without capital allowances.

While the statutory rate remained relatively stable, the computed effective rates fluctuate significantly falling from a peak of 30% in 1980 to around 10% in 1974, but still much lower than the statutory rate of around 48%. There are a number of factors that may have contributed to these movements. The underlying profitability of the firms in the sample is likely to be an important factor. It relates to both real profits and inflationary impacts (Mayer (1982) analysed these effects). However, the main contributor to these changes is probably the tax provisions as analysed above. The low level of the effective corporate tax rate in 1974 is due to the range of measures introduced with effect from 1973 (stock relief, 100% first year allowance for plant and machinery and the imputation system), thus leading many firms to tax losses. The decrease in the effective rate in 1978/79, on the other hand, may be due to the sharp rise in inflation, thus increasing the level of stock relief deductions. It may also be due to an increase in investment expenditure, thus rising the amount of allowances claimed. In order to distinguish between the effects of each of these allowances the effective corporation tax rates were computed on the assumption that the existing deduction was not available.

If the tax system did not allow for the stock relief the effective corporation tax rate could have been more stable and much higher than the computed effective rate under the existing system, reaching a low of only 34%. It is striking to see that a major explanation for the lowest level of tax in 1974 is the introduction of the stock relief. Prior to around 1977, most of the heavy falls in the tax rates can be explained by the stock relief provision. The change in the system in 1981 is well portrayed by the decrease of the importance of the stock relief as a major determinant of the effective rates.

The deductions of capital allowances also play an important role in explaining the corporation tax rates, as portrayed in Figure 2. In particular, after 1977, most of the movements in the tax rates were due to the initial and depreciation allowances. If for instance companies were not permitted to deduct such allowances in 1980, they would, on average be paying nearly the statutory corporation tax. This importance of capital allowances after that date may be due to the increase in initial allowances for buildings from 50 to 75%, because if these allowances were not available, the effective corporate tax would have increased.

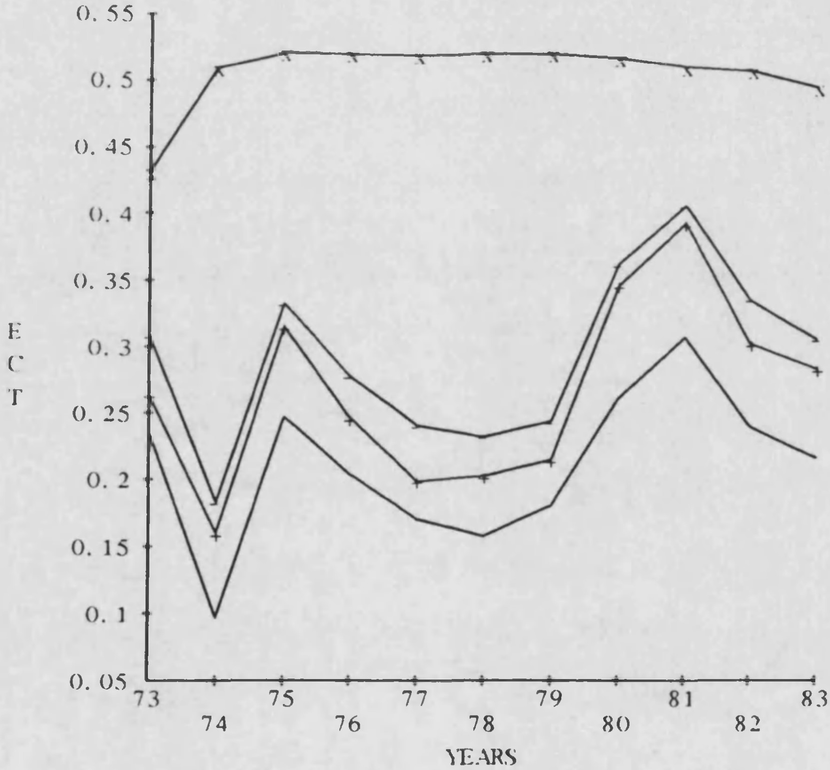

Figure 3. Impact of interest deductibility and ACT

Notes : --x-- Standard rate of corporate tax (adjusted for small firms);

----- Effective corporate tax (ECT);

--+-- ECT without interest deductibility;

--_-- ECT under classical corporation tax system.

As far as the magnitude of other deductions is concerned, the trend is roughly the same as depicted in Figure 3. If companies had not the possibility of deducting interests from their taxable income, their effective corporate tax would have been slightly higher. Similarly, if the classical system of corporation tax was in operation, companies would have paid more tax (however, this effect may be underestimated because of the condition under which companies may deduct the ACT). However, both these deductions do not seem to go far away from the actual trend of the computed tax under the existing system. This may explain the relative stability in the level of interests and dividends payments.

3.2.2 Tax exhaustion : An alternative method of analysing the above effects is to look at the number of companies that are tax exhausted under the existing system and also at those that would have been in such position if particular provision was not in operation during the sample period. As seen above, the major determinants of the effective tax rates are the deductions of stock relief, capital allowances, interest and ACT. The importance of each provision is portrayed in the following table.

TABLE 2.2. PROPORTION OF TAX EXHAUSTED COMPANIES

SIMULATION OF TAX EXHAUSTION					
YEARS	ECT (1)	ECT0SR (2)	ECT0CA (3)	ECT0ID (4)	ECT0ACT (5)
1973	20.75	01.89	15.24	19.81	16.98
1974	41.51	02.83	19.05	33.02	32.07
1975	21.70	10.38	14.28	18.87	21.70
1976	25.47	02.83	19.42	22.86	20.70
1977	35.85	08.49	13.33	26.42	31.13
1978	35.85	07.55	13.33	22.64	28.30
1979	40.57	08.49	12.38	24.53	33.01
1980	32.38	11.43	14.56	18.87	28.57
1981	24.53	11.32	20.58	18.87	28.29
1982	27.36	17.92	08.49	19.81	23.58
1983	25.47	18.87	16.19	16.04	21.69
average	30.00	09.00	15.00	22.00	26.00

ECT is the effective corporate tax (ECT) under the existing system;
ECT0SR is the ECT with non-deductibility of stock relief;
ECT0CA is the ECT without deducting capital allowances;
ECT0ID is the ECT with non-interest deductibility;
ECT0ACT is the ECT under the classical system.

The above table shows the percentage of companies that are tax exhausted under different assumptions of the non-deductibility of capital allowances, stock relief, interest payments and if the imputation system was not operating during the sample period. The first column indicates that in 1974 nearly 42% of the companies in the sample did not pay tax. In this first case, the firm is considered to be tax exhausted if its taxable profit after allowing for all deductions is negative[9]. The rise in the proportion of tax exhausted companies in 1974 comes from the set of reliefs companies where allowed to claim, but the decrease in the number of these tax exhausted companies in the subsequent two years may indicate a rise in profitability. On average during the sample period, the existing corporation tax system together with the profits attained has resulted in 30% of the 109 companies to be tax exhausted. This is a relatively significant proportion given that the proportion varies between 20 and 40% . Thus some companies may have been tax exhausted during the whole sample period.

This situation is not caused solely by capital allowances. As analysed above, stock relief, interest and ACT are also deducted from the taxable profit. Furthermore, losses carried forward may also be of some importance in explaining tax exhaustion position. In order to isolate the importance of each of these elements it is necessary to simulate the results obtained from the tax model to see what happens if particular provision is not in operation.

The second column of the above table is computed on the assumption that companies were not allowed to claim stock relief. Assuming that the absence of this provision did not alter the behaviour of the companies, the proportion of companies that would have been tax

9. These deductions are capital allowances, stock relief, net interest payments, advance corporation tax and taxable losses carried forward. Double taxation relief (DTR) is equal to zero for all the firms in the sample because only domestic companies are considered.

exhausted could have been as low as 1.9% as opposed to 21% under the existing system in 1973. Moreover the effect of stock relief is more pronounced in 1974, where only around 3% of the companies would have been tax exhausted as opposed to 41.5% with the relief. Thus, 92 per cent of the companies that are tax exhausted in 1974 were only in this position because of the deduction of stock relief. Although the importance of stock relief as a major explanation for tax exhaustion has decreased significantly after 1981, because of the introduction of a more sensible method of adjustment applied to movements in stocks, the overall importance during the whole sample period is still highly significant, being 9% as opposed to 30% if provision is allowed for stock relief.

The second column describes the levels and the changes in the number of tax exhausted companies if the corporation tax system did not include any capital allowances. As compared to the previous column, the impact of capital allowances is not as significant as the stock relief. With the exception of the last two years of the sample period, the proportion of tax paying companies would have been substantially higher if the stock relief provision was not in operation rather than if no capital allowances were available, *ceterus paribus* . This fact has important policy implications. It could be the case that companies increase their stock unnecessarily to take advantage of the stock relief, but this reduces their debt-capital ratio because, as we will see below, tax exhaustion situations have a negative effect on the financing policy. Given the relatively constant initial allowance on capital expenditure during the sample period, the movements in the tax exhaustion companies under the assumption of no allowances is determined mainly by the amount of investment expenditure undertaken during the corresponding periods. Compared to the previous graphs, tax exhaustion seems to follow the same broad pattern as the effective corporation tax rates, but the relationship is not symmetrical because of the significant variation in the effective tax rates. On average, if no capital allowances were available during the sample period, only around half the existing number of tax exhausted companies could have been in this situation.

The relative importance of interest deductibility for tax purposes is function of both the levels of interest rates and the level of debts. On average the proportion of tax exhausted companies is not significantly different from the original computation (i.e. when all allowances are taken into account), when compared to the effects of deductions of stock relief and capital allowances. However, the significance varies from one year to another. For instance if the respective figures for 1974 and 1979 were compared, we can see that the proportion of tax exhausted companies varies from 33% to 24%. This may be partly due to the rise in the base lending rate from 11.5% to 17% between the last quarters of 1974 and 1979.

The proportion of tax exhausted companies if the classical corporation tax system was in operation is very similar to that under the existing system. However this column does not necessarily measure the full effect of the imputation system, because as pointed out above, companies can deduct the ACT from their mainstream corporation tax liability only in the case where the gross distribution that forms the basis of the ACT deduction does not exceed the taxable profit. Given that the present system allows first the deduction of the stock relief and capital allowances before ACT, and the high importance of these two deductions as seen from the first two columns, the importance of ACT may be highly underestimated.

4. Conclusion :

This chapter has dealt with a number of controversies that surround the corporation tax. In particular, attention was focussed upon the reasons for the existence of the corporation tax and the basis for taxing companies. Although there is no apparent reason for the existence of corporation tax, since it does exist, it has effects that are worth analysing. The last section has presented some results relating to the determinants of the effective corporation tax. It was found that the capital allowances and the stock relief provide the major explanation for the movements in the effective rates, but if the stock relief was not in operation then there could have been significantly more companies paying tax. In the next chapters, the effects of the tax exhaustion position will be analysed in relation to the financial and investment decisions of the 109 companies in the sample.

CHAPTER III

THE EFFECTS OF TAXATION ON THE FINANCING POLICY OF THE FIRM

One of the reasons of the existence of corporation tax is for the government to influence the firm's behaviour. The effects of taxation on the firm's financing decision may be seen in this context. Many governments proclaim that changes in the corporate tax has as main purpose a promotion of a different pattern of the financing of the productive investments. The question, however, is, first of all, how does the tax system affects in reality the financing behaviour of corporations, and, secondly, how can the firm respond effectively to such influences arising from a combination of a variety of personal and corporate tax in order to efficiently finance its investments.

The existence of taxation which discriminates between the 3 major possible methods of financing a given investment (i.e., debt, retained earnings and new issue of shares), could make the investment policy of the firm dependent on its particular financing policy. As far as the corporate tax is concerned, the main advantage of debt finance comes from the fact that the interests payments are tax deductible expense, while dividends and retained earnings are not. Therefore, the return to bondholders escapes taxation at company level, and the corporate tax provides a tax shield to the levered firm, i.e. as if part of the interest rate is paid by the government. However, such arguments could be valid only in a situation where a company pays tax, where no bankruptcy risks are taken into account, and also where all kinds of personal income are taxed at the same rate.

The present chapter applies the corporate tax rates computed in the previous chapter to study the ways in which various tax provisions affect the choice of the financing policy pursued. The first section starts by providing a brief summary of the theories of capital structure in the absence of taxation. Though the main purpose of this chapter is an analysis of the effects of taxation on the firm's financing decision, this summary is necessary as it constitutes a basis for comparison when taxes are introduced.

Section 2 deals with the tax determinants of the financing behaviour of the domestic firm. The two taxes that can affect a firm's capital structure are the corporation tax and the personal income tax. This constitutes the basis for a pairwise comparison amongst a number of possible financing policies to determine how a given investment policy can be financed, and thus setting a possible optimum level of debt-equity ratio.

Section 3 presents the model used to test the relationship between the level of debts as a proportion of total capital used, the tax variable and the risk element that may prevent the firm from increasing indefinitely its long term borrowings. This is followed by the methodology employed in such tests. Section 5 presents the results obtained using both the OLS and the SUR technique, for the pooled cross-sectional and time series data and for individual cross-sectional for each year in the sample period.

1. Theories of Gearing Ratio :

In order to finance its expansion and its replacement investments, a firm needs to either use its retained earnings, issue new shares, increase its level of debts or employ any combination of the 3. The decision as to what method of finance to use to increase its market value has been a subject of a number of controversies amongst researchers in the field. Different conclusions have been reached depending on which assumption the particular model is based. The present section does not intend to review all the vast past literature on the subject (see Chen and Kim 1979 for a summary), but rather give only a brief insight to the models of gearing ratio.

1.1 Capital structure in a world without tax and risk:

The first main contribution to the analysis of the firm's financial policy is that of Modigliani and Miller (1958, 1963) in which they state that in a world without taxes and no bankruptcy costs, corporate financial policy is irrelevant. They went on to say that the owners of the firm will be indifferent to the debt-equity ratio or to the dividend pay-out ratio, when investment policy is held constant. Basically, this means that a firm cannot change the total value of its securities just by splitting the cash flows into different streams because the firm's value is not determined by the securities it issues but rather by its underlying real assets. Therefore, given a particular investment policy, neither dividends nor the methods of finance used can affect the value of the firm. This leads to a complete separation of the investment and financing decisions. Furthermore, the arbitrage and the perfect substitutability of personal and corporate borrowing allows shareholders to undo any decision of the firm and get their desired debt-equity ratio without harming the firm's market value. These arguments of the irrelevance of the firm's financial policy can also be extended to the aggregate financial policy of the corporate sector as a whole. Such conclusions are however based on some restrictive assumptions.

The model did not take account of the bankruptcy costs. The interest rate faced by everyone is the same independently of the amount borrowed and of the nature of the borrower. Thus individuals and companies are all treated in the same way. Furthermore, firms and individuals are expected to be able to pay interest each period and also pay back the nominal amount of debts when the contract expires. The possibility of not being able to fulfill these requirements is not accounted for. What makes, in fact, this assumption binding is more the cost involved rather than the existence of the bankruptcy itself. If, for instance, the firm can go bankrupt without entailing any costs and there are still perfect substitutes for the firm's debt and equity in other available securities then the firm's leverage is irrelevant. For instance, Stiglitz (1969, 1974) incorporates some other assumptions to prove that with costless bankruptcy, corporate financial policy is irrelevant. These conditions refer to the existence of financial intermediaries who can create any securities the firm can create, and also are willing to repackage without costs the financial structure of the firm whenever it might be profitable. But in the real world these conditions may be difficult to implement.

1.2 Bankruptcy Risks :

Bankruptcy, when it happens, incurs some costs such as expenses for lawyers, accountants, which cannot be predicted. This uncertainty increases the usual risk of the returns on investment. Bankruptcy puts equity holders in a higher risk relatively to the bondholders, because the latter are paid first, before shareholders. In relating the bankruptcy risks to the measurement of the market value of the firm, researchers find it very difficult to first of all, define the bankruptcy costs and, secondly, to measure them.

An earlier study by Warner (1977) found that on average an eventual direct costs of bankruptcy amounted to 5.3% of the market value of the firm's securities and for the largest 11 railroads the costs were 1.7%. These estimations are, however, only correct at that particular period of time and for that particular country and for these particular firms studied. He also questioned whether these estimates are high enough to discourage the firm from increasing its borrowings. The definition of the bankruptcy costs also varies from one study to another. Chen and Kim (1979) and Jensen and Meckling (1976) relate these costs to the agency costs resulting from the arrangements needed to protect the creditors. Myers (1977) on the other hand, defines these costs in terms of the opportunity costs, referring to the valuable opportunities which will be lost for the firm with high potential growth, while Kim (1982) measures the implicit bankruptcy costs by the ex-post amount of the unused non debt tax shield. Mayer (1981) considers the potential penalties on managers on the event of dismissal.

However, neither theory nor empirical evidence suggests substantial costs of bankruptcy for the firm's investors. The measurement of this risk of bankruptcy is also a major problem. Although, theoretically, one can see that there is always the possibility that the firm may not able to pay the interests on its debt, the probability of this happening is very difficult to measure. Taffler (1984) surveyed the different Z-score models that are employed to assess company solvency. The objective was to find a probability that a company will go bankrupt using a set of discriminant variables. However, the variables found to be significant are different from one study to another. Furthermore, he found that the model may depend on the industrial classification and on the size of the firm.

An alternative model of measuring the risk of bankruptcy is to assume that the risk premium required by the shareholders is a function of the debt equity ratio of the firm. The modern financial theory stipulates that, one way of computing the required rate of return by shareholders is by using the capital assets pricing model (CAPM) which takes account of the systematic risk associated with the firm's quoted stock. The cost of capital is thus computed as a function of the return on the market, the risk free rate and the systematic risk for each company. The formula used is :

$$R_e = R_f + \beta(R_m - R_f) \qquad (2.1.1)$$

Where R_e is the equity cost of capital, R_f represents the risk free rate of return, R_m is the mean return from investment in the stock market and β measures the systematic risk associated with a particular quoted share.

Hamada (1969), Rubinstein (1973) and Bowman (1979, 1981) used the above equation (3.1.1) to allow for the effect of gearing. They derived the security systematic risk as a function of the debt-equity ratio :

$$\beta_s = \beta_u (1 + \frac{D(1-\tau)}{S}) \qquad (3.1.2)$$

Where β_s is the geared beta, β_u ungeared beta, D the amount of firm's debts, S the level of equity and τ is the tax rate applicable to corporate borrowings. Multiplying both terms of equation (3.1.2) by the difference between the market return and the risk free rate we obtain :

$$(R_m - R_f)\beta_s = (R_m - R_f)\beta_u (1 + \frac{D(1-\tau)}{S}) \qquad (3.1.3)$$

Therefore investors' risk premium increases the higher the debt equity ratio. Empirically, Hamada (1972) found a strong positive relationship between financial leverage and β for a sample of 304 companies over the 1948-67 period. Moreover, Mandelker and Rhee (1984) reported a highly significant positive relationship between β and leverage using portfolios based on a sample of 255 manufacturing firms during the period 1957-76.

Another way of measuring bankruptcy risk is by computing the interest rate faced by each company. Similarly to the portfolio theory, the return to bondholders/banks could be a function of both the risk free interest rate plus a premium for risk (a 'spread' in international banking). The former is common to all companies. According to Fisher, it is determined by the amount all firms are willing to invest and the amount all individuals are willing to save. The latter, on the other hand, corresponds to the level of risk each firm is in, which, in turn, increases the higher the level of outstanding debts. Since interests are paid before allowing for dividends, the risk premium on debts is expected to be lower than that required by shareholders.

1.3 The introduction of taxation :

From the above section it was clear that since a high level of debts relative to total capital leads to a rise in bankruptcy costs which are manifested through the high returns required by both shareholders and bondholders, firms are expected to reduce their level of debt finance. On the contrary, because of the deductibility of interest payments from profits before tax, corporation tax offers strong incentive for debt finance.

Furthermore, in deciding on the method of finance to use, the firm may also consider personal income tax of the investors. The difference between bondholders and shareholders does not only stem from the fact that the former category escapes corporate tax, but also that the income of shareholders is taxed at personal income tax rate and at capital gains tax rate. Since the latter rate is likely to be much lower than the marginal income tax rate of the shareholder, because of the allowances and the deferment, the overall after tax rate of return may be higher for shareholders than for bondholders. The present section deals in details with the effects of corporate and personal income taxes on the debt equity ratio.

1.3.1 Tax advantages of debts: The second element that makes the original Modigliani and Miller's theory to fail to hold in the real world is the existence of taxation. Corporate tax systems allow interest payments to be tax deductible expense while dividends and retained earnings are not. The advantage of debt finance is that it provides a tax shield to the levered firm. If the company borrows for only one period then the present value of the tax shield equals the product of the marginal tax rate by the interest payment, i.e.

$$PVTS_t = CT_t * RD_t * B_t. \tag{3.2.1}$$

Where PVTS is the present value of the tax shield;

CT is the corporate tax rate;

RD is the interest payment on outstanding debts B.

If on the other hand the debt of the levered firm is irrecoverable then the present value of the tax shield is given by the product of the corporate tax rate by the expected interest payments, discounted in perpetuity by the expected return on debts. The discount rate depends critically on the ability of the firm to generate enough cash flow to cover interest payments. Assuming for the time being that the risk is already included in the interest rate charged, i.e. the risk of the tax shield is the same as that of the interest payments generating them, then the present value of the tax shield is :

$$PVTS_t = \frac{CT_t * RD_t * B_t}{RD_t} \tag{3.2.2}$$

$$= CT_t * B_t.$$

The market value of a levered firm equals to the sum of the market value of its all equity financed and the present value of its tax shield.

$$V(l) = V(u) + CT * B(t) \tag{3.2.3}$$

Where V(u) is the market value of an unlevered firm.

Modigliani and Miller (1963) derived this formula as a correction of their earlier article (Modigliani and Miller 1958) and argue that on the assumption that

i) all corporate returns are taxed equally at personal level, and

ii) the tax savings from the use of debt can be regarded as a perpetual riskless flow,

then the market value of a levered firm is increased at a rate equal to the corporate tax for each unit of debt in its capital structure. Therefore the introduction of corporate tax makes it more advantageous for a firm to be 100% debt financed. One would expect the present value of the tax shield to be highly correlated with the corporation tax rate, and the firm will be indifferent between debt and equity finance only when the corporate tax is equal to zero.

However, in reality, companies typically finance only about one quarter of their accumulations of capital by actually issuing debts. At the aggregate industrial and commercial companies, ICCs, the average level of net debts over the market value of ordinary and preference shares amounted to 0.27, over the period 1973-1983[1]. Furthermore, over the sample period, the proportion of long term debts over total capital averaged 0.1, while the ratio of long term debts over shareholders funds was 0.173. The question is, therefore, to find why the straight forward *all debt* result as reached by Modigliani and Miller (1963) is not applicable.

A number of studies during the mid 70s have taken the middle of the road and argue that an optimal level of debt equity ratio could be set

1. Net debts is computed as the sum of bank borrowings *plus* debts and loan stock *plus* other loans *minus* liquid assets. (Data supplied by the Bank of England).

to reflect the trade off between the tax advantages and the bankruptcy risks (Brennan and Schwartz (1978), Chen (1978), Kim (1978), Kraus and Litzemberger (1973) and Scott(1976)). Therefore, even, as argued above, the costs of bankruptcy are very hard to assess, they may still act at reducing the advantages of taxation. More recently Gordon and Malkiel (1981) have presented models with explicit bankruptcy costs which reduce the advantages of debts finance at the margin and encourage firms to equity finance. It is not only the existence of bankruptcy costs that may prevent the firm from financing all its investment projects with debts, but also personal income tax rates of shareholders and those of bondholders.

1.4 Effects of personal income taxes :

The financial theory of the firm is further complicated when the marginal income tax rate of investors is incorporated into the model. Provided that interests on bonds and returns on equity are taxed at the same rate, the introduction of personal taxes would not affect the debt-equity ratio. However, the income of bondholder is likely to be taxed at a different rate than the income of shareholder, because of the fact that shareholder is taxed at both personal income tax rate and capital gains tax rate, while bondholder is only taxed at personal income tax rate. Capital gains are taxed at lower income tax rate because of the partial exclusion and deferment advantages. In UK the first 5000 Pounds capital gains were not taxed in 1982. Furthermore, capital gains are not taxed when they occur but rather when they are realised. This makes the effective capital gains tax much lower than the statutory rate and debts may not always be preferred to dividends. Before undertaking a pairwise comparison between taxation on debts and dividends, it is worth reviewing the Miller (1977) equilibrium.

Miller (1977) argued that, in the presence of a progressive personal income tax with favourable treatment of equity income, there is an equilibrium in which firms will be faced with the same cost of capital for debts and equity. This equilibrium will be reached when the tax advantages to debt are overridden by the combination of the marginal personal tax disadvantages to debts with the supply side adjustment by firms. This will drive market prices to an equilibrium implying that firm's leverage will be irrelevant.

Let τ_E^i and τ_D^i be the effective tax rates on equity and debt income respectively faced by investor i, and suppose that τ_E^i is a fixed proportion, ψ, of τ_D^i, i.e.

$$\tau_E^i = \psi \tau_D^i$$

An investor will be indifferent between holding debt and equity only in the case where :

$$(1 - \tau_D^i) r_D = (1 - \psi \tau_D^i) r_E \qquad (3.2.4)$$

Where r_D and r_E are the returns on debt and equity respectively. As τ_D^i increases, the interest rates rises to entice investors with high marginal tax rates into the market for corporate debt. On the other hand, firms are indifferent between issuing debts and equity only when :

$$r_D (1 - \tau_c) = r_E \qquad (3.2.5)$$

Where τ_c is the corporate tax rate.

Given that the equilibrium occurs when the supply of debts equals to demand, then the firm will be willing to offer debts until the following equality, for marginal investor, is satisfied :

$$(1 - \tau_c)(1 - \psi\tau_D^{i*}) = (1 - \tau_D^{i*}) \qquad (3.2.6)$$

Investors are thus expected to be split. Those in personal tax brackets below τ_D^{i*} will hold only debts, while those in higher tax brackets will hold only equity, as this provides the highest post-tax rate of return. This suggests that taxation has important effects on the financial structure of the firm. Corporation tax together with the proportion of shareholders who pay income tax at a rate lower than the corporation tax are the main determinants of the debt-equity ratios of corporations as a whole. At individual company, there is no optimal debt-equity ratio, because, once full arbitrage is taken place in the market, no single firm can gain from increasing its level of debts.

Cordes and Sheffrin (1981) argued, on the other hand, that the observed relative returns to fully taxed and tax exempts assets are not consistent with Miller's equilibrium. Firms do not supply debts inelastically at a point where :

$$r_D = \frac{r_E}{(1-\tau_c)}$$

but rather diminish the interest rate they are willing to pay as the level of debts supplied increases, because of possibility of bankruptcy costs. Thus equation (3.2.5) becomes :

$$r_D(1 - \tau_c) < r_E \qquad (3.2.7)$$

In other words, there should be a premium on the rate of return to equity in order to obtain equilibrium.

Miller basic analysis implies that investors are classified into high and low gearing firms according to their tax rates (Kim, Lewellen and

McConnell (1978)). This specialisation is however moderated in the presence of risk aversion and Auerbach (1982), Auerbach and King (1983), Kim (1982) and Modigliani (1982) consider the trade-off between the tax advantages and risks costs associated with specialised portfolios[2].

In order to test shareholders' leverage clientele, and thus the firm debt-equity ratio, one cannot undertake cross-sectional tests of the relationship between firm's leverage ratios and shareholders and bondholders personal tax rates, because their clientele is defined in terms of portfolios not individual firm. Thus Kim & al. (1978) test for the existence of shareholders clientele at the firm level could be misleading. In order to examine the effects of taxation on the way on which shareholders borrow or lend, the data should be on the individual's portfolio composition. Auerbach and King (1983) explored the portfolio behaviour of investors differing with respects to both tax rates and risk aversion in a general equilibrium model. Investors are segmented by tax rate into 2 groups, one specialising in equity and the other in debts. They argue that when investors face different tax rates, there should be some conditions in the market for equilibrium to exist. In this case where value maximisation is optimal for companies, then investors will be completely specialised in either debt or equity. They conclude that relative wealths of the two groups determines the aggregate debt-equity ratio and each firm

2. In a general equilibrium model of taxation, Feldstein and Slemrod (1980) have argued that portfolio diversification is a primary reason why both high and low income taxpayers invest in both sectors : incorporated which is highly taxed and low taxed unincorporated sector.

is indifferent to its financial policy.

However, such results cannot be generalised because of the disparities amongst the shareholders personal income tax rate. In addition such tests do not take into account the corporation tax rate as effective to the firm. Because of the wide variety of the composition of shareholders' income tax rates the firm financial leverage is unlikely to be explained by income tax alone.

In the next section we analyse conditions under which debts may be less attractive to companies because of the combination of relatively favourable treatment of dividends by the imputation system, lower effective capital gains and non-interest related tax shields.

2. Comparison of Alternative Methods of Finance :

In order to determine the optimal level of debt, King (1977) and Nickell (1978) compared in pairs the three alternative methods of finance available to the firm, under conditions of certainty and perfect capital markets. The idea behind this comparison is the determination of the conditions of the tax variables under which for instance, issuing new shares is a better alternative than increasing the level of debts. If taxation is the only variable that affects company's financing decision, then it is possible to determine which source involves paying the least amount of tax by comparing any two of the sources of finance while holding the third constant along with the investment plan of the firm. The decision on whether to use debt finance is accomplished through the following comparison :

a)Chose between debt and new equity : assuming that firm's investment plan and retentions are constant over time, then the managers have to decide on which alternative finance to use in t-1 to yield the best return in t. If debts are chosen then the return in t is paid out as interest. On the other hand, if investment is financed by new issue, then the return is paid out in the form of dividends in order to keep the retention constant. Thus the net after tax return to the supplier of finance is (1-m) if project is debt financed, m being the marginal income tax rate, while if new issues are used, then the firm pays corporation tax on the return and an additional tax on the dividends. As a consequence, the return to shareholder is $(1-\tau)\theta$ where τ is the corporation tax rate and $\theta = (1-m)/(1-c)$, is the opportunity cost of retained earnings in terms of dividends foregone, as defined in the previous chapter. In these circumstances, the firm will prefer debts to new equity if $(1-m)>(1-\tau)\theta$.

Under the classical system of corporation tax, where $\theta = 1-m$, firms will prefer debts to new equity for any positive value of corporation tax rate (DeAngelo and Masulis 1980b). The introduction of the imputation system alone would not modify this preference for debts so long as the corporate tax rate is higher than the imputation rate (Fung and Theobald 1984). This analysis, therefore, depends crucially on the level of the corporation tax rate. If the statutory corporate tax rate is used then this comparison would not explain the relatively low levels of debts-capital ratios as observed for our sample of companies and for the aggregate industrial and commercial companies.

b)Chose between retentions and debts : Suppose that dividends and new equity finance are constant, then if investment plan is financed by debts, the after tax return paid out as interest is equal to (1-m).

If on the other hand retained earnings are the main source of finance then the value of equity in period t will be higher than otherwise. The retained earnings are subject to both corporation tax and also to capital gains tax on the consequent appreciation of the value of equity. Therefore, the net return is $(1-\tau)(1-z)$ where z is the effective capital gains tax rate. Debts finance is thus preferred to the use of retained earnings on the condition that $(1-m)>(1-\tau)(1-z)$.

If we suppose that the marginal income tax rate is equal to the effective capital gains tax rate, then debts will still be preferred to dividends so long as the corporate tax rate is positive. Given that the capital gains are taxed at a standard rate rate of income tax, the marginal income tax rate m is bound to be always higher than the capital gains tax rate for a higher tax bracket taxpayer. Therefore, the ratio $(1-m)/(1-z)$ is always lower than unity. As a consequence, debts will be preferred to retained earnings if the corporation tax rate is higher than the relative proportion of the difference between the marginal income tax rate and the capital gains tax rate. If the standard rate of corporation tax is used, then we are likely to find, at any time, firms to prefer debts to retained earnings.

Nickell (1978) found that in the US or UK personal and corporate tax system debt is preferable to retentions and retentions is preferable to new share issues. This conclusion does not, however, take into account the effective corporate tax rate. As a consequence it may not explain why companies do not borrow heavily.

King (1977) is the only one to have carried out formal time series tests of the explanatory power of the tax advantage of debts on company debt-equity ratio. In a two period certainty framework, he conducted regression tests of UK aggregate industrial and commercial companies' debt ratios for the period 1963-1971 against the tax advantages of debts which include both corporate and personal taxes. Although he concludes that the determinants of debt-equity ratio can be obtained from a simple relationship between the target debt-equity ratio and the tax variables, his results are somewhat mixed with the coefficient of only one of his two explanatory variables $[\theta(1-\tau)-(1-m)]$ is significant and with expected sign (i.e. negative). Furthermore, his results may be due to the short time period used[3]. His theory, in addition to his strong assumption of perfect capital markets and certainty, considers the three alternative methods of finance as mutually exclusive, while in reality firms usually use a combination of debts, new issue of shares and retained earnings.

The above analysis did not take into account the noninterest-related tax shields in computing the corporation tax rate. In the previous chapter, we found that, because of the tax reliefs and allowances, the effective corporation tax rate is substantially lower than the statutory rate. Since the above comparison is mainly based on the level of the corporate tax rate of firms, we would expect that a lower effective corporate tax rate would change the preference for debts. DeAngelo and Masulis (1980a) extended the original Miller (1977) analysis by considering the noninterest-related tax shields to demonstrate the relevance of corporate leverage policy. Fung and Theobald (1984)

3. The total period is divided into two sub-periods on which the regressions were performed : 1954 to 1961 and 1961 to 1971.

extended this analysis to prove that the combination of the loss of tax shields with shareholders credit method or the firm's dividend credit method makes the dividends dominate debts. However, none has dealt with the simultaneous relationship between the corporation tax rate, personal income tax rate and the effective capital gains tax rate.

To formalise the relationship between personal taxes and corporate tax, we define m, c, z, and τ as the marginal personal income tax rate, imputation rate, effective capital gains tax rate and the effective corporate tax rate. The return on debts are taxed only at personal level, making the after-tax return equal to (1-m) for each unit of interest. The return to shareholders, however, depends on the dividend pay-out ratio, defined as α. For each unit of dividends shareholder will be taxed at a rate (1-m)/(1-c), and for each unit of capital gains, generated by the retained earning, he will be taxed at rate z. Therefore, his total return would have been taxed at :

$$(1-\tau)(\alpha\frac{(1-m)}{(1-c)} + (1-\alpha)(1-z))$$

Therefore, the decision on whether to use equity as opposed to debts would be based on the following relationship :

$$(1-m) < (1-\tau)(\alpha\frac{(1-m)}{(1-c)} + (1-\alpha)(1-z)) \tag{3.2}$$

If the inverse relationship is true then we would expect the firm to prefer debts to equity.

Equation (3.2) is tested for our sample of companies. We assumed a fixed 20 per cent return before-tax on both debts and equity.

This comparison require the computation of the effective capital gains tax rate. As pointed out above the statutory rate may not reflect the actual tax paid by the shareholder because capital gains tax is not on accrual basis but rather on realisation. Data on the period of holding shares is not available. We follow King (1977) methodology and assume a propensity to sell assets of 10 per cent and compute the effective capital gains by discounting the future notional rate of capital gains tax[4]. During the sample period there have been some major changes in the capital gains tax. In particular, in 1982 the tax system allows the acquisition cost of the asset to be indexed against inflation. Moreover, the amount of allowances changes during the sample period and individual were allowed to opt for an alternative way of taxing their capital gains.

This comparison requires also the computation of the dividend pay-out ratio, average marginal income tax of shareholders and the effective corporation tax rate. The latter is dealt with in the previous chapter and the marginal income tax of shareholders is based on the national average, as computed in chapter 4.

4. The standard rate of capital gains cannot be applied because individuals may elect for an alternative basis under which one half of the gains are taxed as income. Data necessary to compute the notional capital gains tax has been extracted from the *Inland Revenue Statistics* various issues. From 1972 to 1980 the yearly capital gains tax rates are calculated using Table 4.21 and 4.24. We divide the tax payments on realised gains on shares and debentures in companies by the amount of gains. These relate to both individuals and trustees and to both assessments methods: on alternative basis and at 30%. For 1981-82 the capital gains tax payments on shares is not published. Instead the total amount of tax and gains -including land and buildings and all other assets- is given. The notional tax rate is computed by dividing the sum of the total amount of capital gains tax paid by trustees and individuals by the total amount of gains realised by both these categories of investors. There was no data for 1983. (See *Inland Revenue Statistics* 1986 Tables 5.2 and 5.3 pp. 67-68).

TABLE 3.1. Hypothetical Example on the Return to Investors

EFFECTIVE TAX RATES AND RETURNS TO INVESTORS								
YEARS	m (1)	NKGT (2)	z (3)	τ (4)	α (5)	c (6)	ATR_B (%) (7)	ATR_s (%) (8)
1972	0.386	0.288	0.167	0.395	0.4460	0.00	12.28	08.90
1973	0.413	0.291	0.140	0.236	0.3037	0.30	11.74	13.04
1974	0.432	0.284	0.115	0.097	0.3631	0.33	11.36	15.74
1975	0.437	0.286	0.117	0.247	0.3649	0.35	11.26	13.20
1976	0.428	0.292	0.119	0.203	0.3250	0.35	11.44	14.04
1977	0.417	0.293	0.129	0.170	0.3091	0.35	11.66	14.59
1978	0.392	0.262	0.117	0.157	0.2687	0.34	12.16	15.06
1979	0.364	0.250	0.109	0.180	0.3044	0.33	12.72	14.90
1980	0.360	0.249	0.105	0.261	0.3150	0.30	12.80	13.32
1981	0.390	0.246	0.100	0.307	0.2560	0.30	12.20	12.37
1982	0.370	0.236	0.104	0.240	0.2934	0.30	12.60	13.64

Notes : Column One : Average marginal tax rate applicable to dividends paid by ICCs. See chapter 4 for the method used. Source 'The Survey of Personal Incomes' and 'Inland Revenue Statistics' Various issues.

Column two : Notional capital gains tax rate, computed by dividing the amount of gains tax by the amount of gains. Source 'Inland Revenue Statistics' Tables 4.21-4.24 & 5.2-5.4. Various issues.

Column three : Effective capital gains tax $z = 0.1*NKGT/(0.1+r)$ where r is redemption yield on long dated government stocks. (See King (1977) for discussion).

Column four : Effective corporation tax rate for the sample of companies. See chapter 2 for details.

Column five : Average dividend-pay-out ratios for the firms in the sample. See chapter 4.

Column six : Advance corporation tax rate.

Column seven: After-tax return to bondholders assuming a before tax of 20% and an average income tax rate equal to that of shareholders. $ATR_B = 0.2(1-m)$.

Column eight: After-tax return to shareholders assuming a before tax return of 20%. This is computed as :

$ATR_s = 0.2(1-\tau)[\alpha(1-m)/(1-c) + (1-\alpha)(1-z)]$.

In column (7) and (8) we compute the after tax return on debts and equity. While the interests are assumed to be subject to only the marginal personal income tax rate, the income of shareholders is taxed, first, at the corporate tax rate, and, second, at personal level. The latter depends on the amount of dividends distributed by the firm, as dividends are taxed at the marginal personal income tax rate, while capital gains are taxed at the effective capital gains tax rate. We assume that there is no timing difference between the payment of dividends and the recovery of ACT and that both dividends and interests are subject to the same marginal personal income tax rate. We find, that with the exception of 1972, the after tax return on equity is much higher than that on debts. Equation (3.2) is, therefore, verified for all the years in the sample period. As a consequence, firms, in order to maximise their shareholders' wealth, may probably have preferred to use equity rather than debts.

However, in this analysis the average corporate tax rate was used. This does not reflect directly the fact that many companies in the sample were not paying tax at all. For a positive dividend equilibrium to exist, firms should be willing to supply debts as opposed to equity. A necessary condition for this equilibrium is for the corporate tax to be negative or zero (Fung and Theobald 1984). In the next section attempt is made to determine the impact of tax exhaustion on the levels of debt-capital ratios.

3. The Model

The review of the literature has shown that debt equity ratios are influenced by both taxes and expected bankruptcy costs. The former implies high leverage, while the possibility of costly bankruptcy predicts the opposite. The present model tries to capture both these influences.

In order to test for the influences of taxation on financing behaviour we look at how debt equity ratios have varied over time and through firms with a variation of a number of explanatory variables. The optimal level of debt relative to its equity the firm wishes to have may be seen as the outcome of some complex interaction between the impact of uncertainty and the firm's tax position.

Because of the allowances created by the tax system, firm could have negative taxable profit without being in financial distress or on the verge of bankruptcy. The strong assumption behind the models reviewed above is that firm is assumed to have a positive taxable profit against which tax shields can be obtained. In reality this cannot be always the case. DeAngelo and Masulis (1980a) model is based on this idea. They argued that the benefits of debts diminish as the taxable capacity of the firm becomes exhausted and as a result it is possible to obtain an optimal level of gearing. In the previous chapter we find that the effective corporation tax rate is much lower than the statutory rate. Therefore, firms in the sample were not able to claim all the tax advantages to debts (Table 2.2, p.47). In 1974, for instance, they were, on average, able to claim only 19 per cent of their tax shields[5], and 41 per cent of them were not able to claim anything at all as their taxable profit is negative. For the whole sample period, firms were able to take only 44 per cent of their tax shields[6]. This situation is, therefore, likely to contribute significantly to the observed low levels of debt-capital ratios of the companies in the sample.

The model tested here is based on these arguments. The tax position of the firm used is the effective corporation tax rate which takes into account capital allowances, stock relief, imputation rate and the level of profitability of the firm. It is assumed that the target debt-capital ratio is linearly related to the tax variables, the previous level of debt-capital ratio and to the level of risk as measured by the required rates of return by shareholders and bondholders/banks. Furthermore, it is assumed that the firm cannot adjust completely, in one period, its target debt-capital ratio because of the costs involved (Myers 1984). The following estimating equation of debt-capital ratio is obtained.

$$L_{t_i} = \alpha + \beta_1 RPRIM_{t_i} + \beta_2 L_{t-1_i} + \beta_3 TAXEXH_{t_i} + \beta_4 LTIR_{t_i} \qquad (3.3.1)$$

Where L is the debt-capital ratio of firm i at time t;

RPRIM is the risk premium required by shareholders to compensate for the bankruptcy costs that may arise from the high level of debt-capital ratio. It is obtained from equation (3.1.3).

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5. The statutory corporation tax, adjusted for small firms, in 1974 was 50.88 per cent while the effective tax rate was only 9.65 per cent. Therefore, they were claiming only a small proportion of their tax shields which amounts to 9.65/50.88 = 18.9 per cent.
6. In the US Cordes and Sheffrin (1981, 1983) find that the marginal tax advantage of interest deductions on debts is only two thirds of the full corporate tax.

TAXEXH is a dummy variable indicating whether the company i is tax exhausted at time t. The effective corporation tax rates are obtained from the tax model, and this variable is defined as the tax exhaustion before allowing for interest payments.

LTIR is the long term interest rate which is assumed to incorporate a premium for risk required by bondholders/banks.

3.1 Variable estimation :

This model is estimated using data extracted from the EXTAT data bank for a sample of 109 firms over the period 1972 to 1983. Market values could have been of more interest than the book values but no data on the market value of debentures was available. Instead data extracted from the balance sheets of the firms in the sample is used to compute the debt-capital ratio for each year, the results of which are plotted in the following graph.

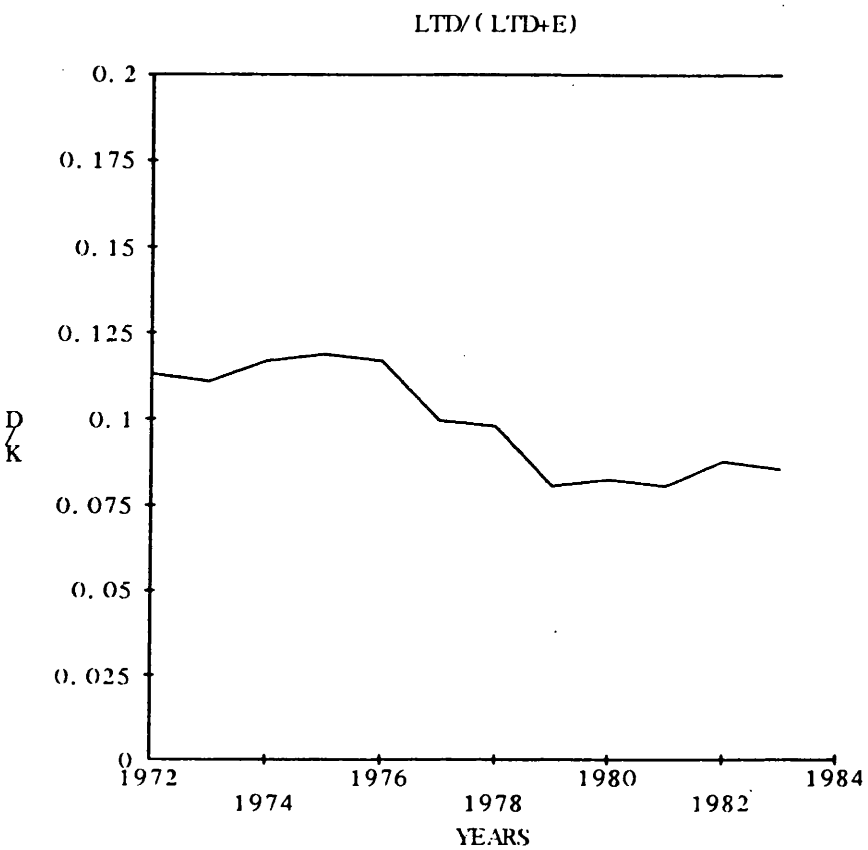

Figure 1. Average debt-capital ratio

The yearly average of the debt-capital ratio has not changed significantly during the sample period, and after 1977, firms appear to rely less on long term debts to finance their projects. For the whole sample period, long term debts represented about 10 per cent of total long term finance, i.e. including provisions and reserves.

The major problem with using individual companies' data extracted from their published accounts is that these accounts are based on accounting conventions which do not allow for inflation. In particular, since one explanatory variable, the risk premium required by shareholders, is based on market values, the computation of debt-capital ratios on historical cost basis may not produce the same results as when market values are used. However, Bownman (1980) and Auerbach (1985) used both market values and book values but did not find any significant differences in their results. Furthermore, to test for the relationship between beta and leverage, Hamada (1972) and Mandelker and Rhee (1984) have used book values of both debts and equity. Therefore, the results are not expected to be biased just because of the use of book values.

The debt-capital ratio variable is computed using data extracted from Extat database. The numerator, long-term debts, is calculated as the sum of bank loans (C140)[7], other loans (C141), debenture parent company (C136), debenture subsidiary company (C137), loan parent company (C138) and loan of subsidiary company (C139). The denominator is the sum of the long term debts and shareholders funds (C132)[8].

Long term interest rate variable is also computed from the Extat data bank. It is the ratio of long term interest payments (C54) over the outstanding long term debts at the beginning of the period. There were, however, some problems in computing this variable, due mainly to the timing of the payment of interest and the redemption or the contracting of debts. In very few cases, there was no relationship between the level of interest payments and the amount

7. Values between brackets refer to Extat numbers.

8. There are a number of ways of computing debt-capital ratio at book value. Bowman (1980) for instance, included such elements as current liabilities and deferred tax in calculating total debts. However, these items do not bear any interest and also may be contracted unintentionally by the firm. Preference capital, on the other hand, is included in shareholders' funds.

of debts outstanding, in such a way as the interest rate was found to be around 60 per cent. This is due to the fact that when the accounts were published, the company may have paid part of its debts but has not completed the payment of interests due. In other cases, the reverse happened. Interest rates were found to be very low (around 2 per cent). This is probably due to the fact that the company may have just contracted new debts and have not started paying interest, thus making the denominator much higher than the numerator. Given that these cases where exceptional and amount to less than 5 per cent of the total sample, such unreasonable observations are considered as missing values.

Risk premium (RPRIM) variable is computed using the capital assets pricing model (CAPM). Beta, the systematic risk, is obtained by regressing the monthly log returns extracted from the London Share Price Database (LSPD), for each company over 5 year period preceding the year in question, thus giving 60 observations for each yearly beta, against the corresponding market returns. The risk free rate of return and the market return used to compute the risk premium are taken as the average return over the whole period[9].

The tax exhaustion variable indicates whether the company is able to take advantage of the tax shields. The effective tax rates are computed assuming that the firm is all equity financed, and profits are adjusted for the actual interest payments. If the effective tax rate is lower or equal to zero, this dummy variable is set to one, and to zero

9. See chapter 6 for the computation of beta, market return and the risk free rate.

otherwise. If, as the theory predicts, corporate tax influences the desired level of debts, then this dummy variable would be significant. This variable is also assumed to constitute a key element in influencing the decision on whether a particular project is financed by debts or equity or retained earnings. This variable is expected to be negatively related to the level of the debt-capital ratio, because the more the company is tax exhausted, the less tax shields gained, thus the lower the debt-capital ratio.

4. Methodology :

To construct a pooled time-series cross-sectional ratios of long term debts to long term capital (long term debts *plus* shareholders' funds), a sample of 109 firms non-financial domestic firms was selected from EXTAT data bank. The data covers 1972 through 1983. The firms are chosen on condition that their main activities are in the domestic market, because international companies are able to borrow in other countries or to use borrowings of their subsidiaries abroad. This fact could distort the results because of the likely differences in the behaviour between international and domestic firm.

Because of the special structure of the data, the frequently used ordinary least squares method is likely to give biased coefficients due to the contemporaneous covariance. This problem arises when a random exogenous factors such as major political events or any other omited variable may affect the independent variable of all the firms in the sample at the same time. The econometric method to use depends on the assumption on whether the error term $v_{i,t}$ is a fixed or random. This depends on v_t being correlated with $X_{i,t}$. For the purpose of this study it is assumed that this relationship is fixed and use Seemingly Unrelated Regressions rather than the Generalised Least Squares with dummy variables. This choice is due to the large number of firms in the sample and a dummy variable for each firm would not have too much explanation. Moreover, the large number of firms comparing to the low number of years (109 as against 12 years) would make this error term insignificant. (Chamberlain (1983), and Nickell (1981)).

The pooled cross-sectional and time series regressions constrain the coefficients of the explanatory variables to be equal through all the years in the sample period. If these coefficients have changed significantly during the sample period then the results obtained cannot be said to reflect the general behaviour of the firms. Cross-sectional data is therefore used for each year in the sample period and the estimates are compared to those obtained from pooled data. However, given the relatively high number of cross-sectional regressions, year to year comparison may not be an efficient way of testing for the significance of time effect. Instead, the Chow test is computed. It involves calculating F statistics as a weighted of the sum of squared residuals obtained from the restricted equation and the unrestricted one. The restricted equation is where all the coefficients are assumed to be constant through time, and the unrestricted equation relates to the coefficients of the cross-sectional regressions. If the value obtained is higher than the critical value then we can say that the results obtained from pooled cross-sectional and time series data are significantly different from those of cross-sectional.

Another problem that may fault the results is the likely presence of heteroscedasticity which arises from the fact that the companies in the sample are not of the same size. Thus if for instance the amount of debts is used as the dependent variable then the high level of debts for large firms may be due to their need rather than to the advantage of corporation tax or to their low risk of bankruptcy. To avoid this mis-specification all the variables are taken as ratios. Long term debts are divided by the sum of long term debts *plus* shareholders' funds, and the remaining explanatory variables are also defined as either rates of return or as dummy variables.

5. Results of Estimating Leverage Equation :

Table 3.2 records the results of estimating equation 3.1 for the pooled cross-sectional time-series data, using both the ordinary least squares (OLS) and the seemingly unrelated regressions (SUR) method, for a total of 88 firms over 11 year period. The total sample includes 109 companies, however, due the missing values the regressions are only performed for 88 companies because the number of observation has to be the same for all years in order to use the SUR.

TABLE 3.2. RESULTS OF ESTIMATING LEVERAGE EQUATION: POOLED DATA

$$L_{i_t} = \alpha + \beta_1 RPRIM_{i_t} + \beta_2 L_{i_{t-1}} + \beta_3 TAXEXH_{i_t} + \beta_4 LTI_{i_t}$$

COEF.	OLS					
	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0017	0.0163	-0.005	0.005	0.030	0.004
	(0.26)	(4.25)	(-0.89)	(0.79)	(2.30)	(0.076)
β_1	0.562	-	0.351	0.581	1.97	0.401
	(2.86)		(1.78)	(2.95)	(5.02)	(2.47)
β_2	0.847	0.853	0.885	0.862	-	0.866
	(57.82)	(58.43)	(66.38)	(59.84)		(72.86)
β_3	-0.013	-0.014	-	-0.013	-0.014	-0.010
	(-3.22)	(-3.45)		(-3.12)	(-1.73)	(-2.54)
β_4	0.136	0.138	0.132	-	0.052	0.089
	(4.47)	(4.53)	(4.08)		(8.68)	(3.80)
$\bar{R}^2$	0.777	0.775	0.776	0.773	0.090	
σ	0.0545	0.0547	0.0589	0.055	0.110	
T.M.						963

Notes : T.M. denotes the trace matrix;

σ is the standard error of estimate;

$\bar{R}^2$ is the adjusted coefficient of determination;

t-statistics in brackets;

At 5% level, t_c = 1.960, (two-tailed t-test).

All coefficients in the above table in column 1 using OLS and when SUR technique is used (column 6) are highly significant and are of the predicted sign. Column (2) to (5) test for multicollinearity amongst the variables using Frisch's Confluence Analysis. Since each time any of the variables included in column (1) is excluded, R^2 is reduced, with a rise in the standard error of the estimates, σ, and lower t-statistics of the remaining coefficients, we can say that, even if there is multicollinearity amongst the variables, its possible effect is not substantial[10].

The most dominant coefficient in term of its significance is the lagged level of debt-capital ratio. In column (5) when this variable is excluded the overall significance decreases significantly. This points out to partial adjustment of firms towards their desired debt-capital ratio. Because of the costs involved and of their commitments when debts contracts are signed, firms cannot just decide to reduce their debts at a particular point in time, but rather they base their decisions concerning any adjustment to their target debt-capital ratio on their existing level of debts.

Tax exhaustion variable confirms the tax shield hypothesis. Together with the risk variables they are consistent with the hypothesis of their respective opposite direction effects on the target debt-capital ratio. If the company expects to take advantage of the tax shields created by the existing tax systems, then it is likely to increase its debts in order to finance its investment projects. On the other hand, if such gains are not possible at present or in the near future because of the tax exhaustion situation the firm is in, then financing a particular project by debts will only lead to an increase in

10. None of these criteria alone is a satisfactory indicator of multicollinearity, because large standard errors do not only arise from the presence of linear relationship among the explanatory variables. Moreover, the overall R^2 may be high but the coefficients may be of the wrong sign or have a lower t-statistics. Thus, the detection of possible multicollinearity should be based on a simultaneous comparison of these criteria, in addition to the correlation between explanatory variables. (Koutsoyiannis 1977).

bankruptcy risks. The coefficient of this variable indicates that if a firm is not paying any corporation tax then it is expected to reduce its debt-capital ratio by about one per cent, while in the long run it is likely to decrease it by 7 per cent[11]. This percentage is significant considering that, during the sample period the debt-capital ratio was on average equal to 0.114. Relating these results to the simulation analysis performed in chapter two, we can say that if the stock relief has not contributed substantially to the high level of tax exhausted companies, the average debt-capital ratio would have been much higher.

The risk premium required by shareholders and the level of interest rates are used as an approximation for the risk associated with a high level of leverage. As expected, both these variables are positively related to the level of debt-capital ratio, meaning that both shareholders and bondholders or banks require higher returns the higher the level of debts relative to the capital of the firm. For two companies with the same level of shareholders funds , the required rate of return for the high levered one is expected to be higher than that which has a lower level of debts. The magnitude of the coefficients of these variables is different. Since bondholders or banks have priority over shareholders in case of bankruptcy, the level of their required rate of return is lower than that of shareholders. For each unit of debt-capital ratio above the *normal level* shareholders

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11. In the long run the present and the lagged value are equal. i.e. $L_t = L_{t-1}$. Solving for the tax variable assuming the other coefficients to be zero, the long run impact of the corporation tax may be found.

would require 0.4 units increase in their required return while bondholders would only ask for a rise of about 0.1 units.

Both the OLS and the SUR lead to similar results. There is no a priori direct test to use to chose between the 2 methods and to test for the existence of the contemporaneous covariance, because the SUR method does not give enough summary statistics. The strong similarity in the results using both methods is probably due to the absence of contemporaneous covariance amongst the error terms of each firm.

The pooled analysis imposes, however, fixed coefficients on the independent variables for each of the 11 years period. If the debt-capital ratios have varied significantly during the 70s then this restriction may bias the results given in table 3.2. Equation 3.1 is thus re-estimated for each of the years 1973 to 1983. The results obtained are reported in table 3.5 and table 3.6 for the seemingly unrelated regressions and the ordinary least squares, respectively.

TABLE 3.3. RESULTS OF CROSS-SECTIONAL REGRESSIONS LEVERAGE: SUR

$$L_i = \alpha + \beta_1 RPRIM_i + \beta_2 L_{i\ 1} + \beta_3 TAXEXH_i + \beta_4 LTI_i$$

YEARS	COEFFICIENTS α	β_1	β_2	β_3	β_4	σ_u σ_r	$F_{5,83}$
1973	0.026	-0.13	0.85*	-0.014	0.48	0.058	0.3315
	(1.14)	(-0.19)	(15.3)	(-0.97)	(0.31)	0.058	
1974	0.017	0.993	0.934*	-0.011	0.073	0.041	1.253
	(-0.97)	(1.74)	(24.3)	(-1.30)	(1.40)	0.042	
1975	0.007	0.27	1.03*	-0.015	0.054	0.050	3.091**
	(0.33)	(0.39)	(23.1)	(-1.30)	(0.57)	0.055	
1976	0.014	-0.33	0.96*	-0.006	0.005	0.031	2.555**
	(1.13)	(-0.79)	(39.9)	(-0.9)	(0.085)	0.033	
1977	0.019	-0.209	0.776*	-0.11	0.035	0.047	2.538**
	(1.06)	(-0.35)	(21.6)	(-1.3)	(0.35)	0.050	
1978	-0.049*	1.39*	0.85*	0.012	0.33*	0.048	1.609
	(-2.51)	(2.11)	(18.1)	(1.06)	(2.88)	0.050	
1979	0.0023	1.25*	0.588*	-0.02*	0.172*	0.051	4.887**
	(0.12)	(2.02)	(12.52)	(-2.25)	(2.30)	0.058	
1980	0.0013	1.16	0.876*	-0.02	-0.09	0.055	1.118
	(0.06)	(1.83)	(12.75)	(-1.44)	(-0.76)	0.057	
1981	0.019	-0.43	0.92*	-0.016*	0.11	0.034	1.151
	(1.52)	(-1.09)	(26.25)	(-2.02)	(1.81)	0.035	
1982	-0.014	0.472	0.95*	0.006	0.097	0.041	0.1468
	(-0.92)	(1.016)	(21.4)	(0.61)	(1.91)	0.041	
1983	-0.03	1.26*	0.818*	0.005	0.35*	0.046	1.773
	(-1.77)	(2.36)	(16.43)	(0.38)	(3.73)	0.048	

Notes: ** significance at 5% level $F_{5,83}=2.329$;

t-statistics in brackets. $t_c = 1.960$ at 5% level (two-tail t-test);

σ_u Standard error of estimates for unrestricted;

σ_r Standard error of estimates for restricted form (pooled);

Number of observations = 88.

TABLE 3.4. RESULTS OF CROSS-SECTIONAL REGRESSIONS LEVERAGE: OLS

$$L_i = \alpha + \beta_1 RPRIM_i + \beta_2 L_{i-1} + \beta_3 TAXEXH_i + \beta_4 LTI_i$$

YEARS	COEFFICIENTS α	β_1	β_2	β_3	β_4	$\bar{R}^2$	σ	$F_{4,83}$
1973	0.028	0.051	0.863*	-0.019	-0.06	0.724	0.059	58.23
	(1.11)	(0.07)	(13.8)	(-1.14)	(-0.34)			
1974	-0.014	1.05	0.94*	-0.018	0.06	0.869	0.042	146.3
	(-0.76)	(1.72)	(23.11)	(-1.79)	(1.113)			
1975	0.032	-0.22	1.01*	-0.03*	0.157	0.849	0.051	123.0
	(1.29)	(-0.29)	(20.30)	(-2.16)	(1.44)			
1976	0.01	-0.21	0.957*	-0.005	0.002	0.94	0.032	342.0
	(0.73)	(-0.45)	(35.40)	(-0.56)	(0.033)			
1977	0.005	0.35	0.728*	-0.013	0.17	0.807	0.047	91.7
	(0.26)	(0.52)	(17.49)	(-1.18)	(1.42)			
1978	-0.058*	1.696*	0.89*	0.014	0.22	0.814	0.049	96.2
	(-2.75)	(2.37)	(17.34)	(1.101)	(1.73)			
1979	-0.014	1.57*	0.62*	-0.017	0.147	0.673	0.052	45.8
	(-0.67)	(2.34)	(12.19)	(-1.30)	(1.70)			
1980	0.011	0.95	0.89*	-0.026	-0.08	0.684	0.056	48.2
	(0.47)	(1.37)	(11.73)	(-1.68)	(-0.61)			
1981	0.015	-0.34	0.93*	-0.014	0.104	0.879	0.035	159.6
	(1.02)	(-0.77)	(23.0)	(-1.47)	(1.38)			
1982	0.042	0.215	0.91*	-0.006	0.105	0.829	0.042	106.7
	(0.26)	(0.42)	(18.71)	(-0.52)	(1.86)			
1983	-0.029	1.27*	0.853*	-0.003	0.35*	0.804	0.047	90.4
	(-1.47)	(2.21)	(15.99)	(-0.26)	(3.43)			

Notes: t-statistics in brackets. $t_c = 1.960$ at 5% level (two-tail t-test);

σ Standard error of estimates;

$\bar{R}^2$ = Coefficient of determination adjusted for the degrees of freedom;

Critical value of F at 5% level is 2.530;

Number of observations = 88.

In the above tables cross-sectional regression results are presented. Because of the missing variables the sample has to be reduced from 109 firms to 88 companies per year. The ordinary least squares sample has to be limited to be the same as that of SUR so that comparison between the two methods may be made. Table 3.5 summarises these results by reporting the number of coefficients that are significant and with the expected sign.

TABLE 3.5. SIGNIFICANCE OF COEFFICIENTS OF LEVERAGE EQUATION

Method	Criteria	$RPRIM_i$	L_{i-1}	$TAXEXH_i$	LTI_i
SUR	Correctly signed	7	11	8	10
	Correctly signed and significant (5%)	3	11	2	3
	Uncorrectly signed and significant	0	0	0	0
OLS	Correctly signed	8	11	9	9
	Correctly signed and significant (5%)	3	11	1	1
	Uncorrectly signed and significant	0	0	0	0

Although a relatively large number of the coefficients of the explanatory variables are of the expected sign, only a small proportion of these are significant. In particular, the tax exhaustion variable is significant in only one case when the ordinary least squares technique is used. When the seemingly unrelated regressions technique is employed, only 25 per cent of the coefficient that are of the correct sign are significant. None are uncorrectly signed and significant. However, in order to be able to compare these results to the one obtained from the pooled cross-sectional time series data, it is necessary to test for whether time exerts any impact on debt-capital ratios.

Table 3.3, column 7 reports the F statistics to measure the degree of significance between the restricted and the unrestricted regressions, using the Chow test which compares the sum of squared residuals obtained from the regression when all the coefficients are constrained to be equal and the sum of squares residuals obtained from the unrestricted specification. At 5 per cent confidence level, the restriction of the coefficients to be the same through all the sample time period is rejected in only 4 cases[12] while accepted in 7 cases. Similarly, table 3.4 which reports the results of cross-sectional using OLS does not show significance differences between the correlation coefficients obtained for each separate year. Moreover, the standard error of the estimates obtained using both the SUR and the OLS techniques are very similar. Therefore, one can say that time has no effects[13]. The Trace Matrix, which measures the sum of the diagonal

12. At 1% confidence level, the restriction is rejected in only 1 case, 1979.

13. The variation through the years in the explanatory variable determines whether time effect is significant or not. The tax exhaustion variable has remained constant through time. It is only with the introduction of the stock relief in 1974 that this variable changed significantly, because more companies became tax exhausted. Otherwise, the proportion of tax exhausted firms has remained fairly constant for the whole period (as analysed in chapter 1).

elements of the covariance matrix of the transformed residuals, of the pooled and cross-sectional results is similar in both specifications[14].

The main difference between the results obtained using the ordinary least squares and the seemingly unrelated regressions technique concern the estimated standard errors of parameter estimates. In general more of the SUR estimates are significant. The test for the appropriate use of the SUR as against OLS is given by the maximum likelihood test statistics computed as (Judge *& al* 1985) :

$$\lambda = T\,(ln\,|\Omega_0| - ln\,|\Omega_1|)$$

Where Ω_1 = the unrestricted SUR error covariance matrix;

Ω_0 = the corresponding OLS error covariance matrix;

T is the sample size.

To test for the null hypothesis that the OLS is adequate Ω is restricted to being a diagonal matrix and λ has then an asymptotic Chi-squared distribution with M(M-1)/2 degrees of freedom (M is the number of seemingly unrelated equations). The statistical package used for this analysis (Time Series Processor) does not provide enough summary statistics to compute this test. We rely on the previous studies which have found that the SUR estimates are more efficient than the OLS ones (Zellner and Huang (1962), Kmenta and Gilbert (1968)), and we confirm this by comparing the sign and the significance of the coefficiences obtained from both techniques.

14. When cross-section data is used for each year the Trace Matrix amounts to 962.95, while when the time is taken as constant its value is 951.43.

6. Conclusion :

Attempt is made in this chapter to explain the observed low debt-capital ratio of the firms in the sample during the 1973-83 period. We have found that, one possible reason for companies to prefer equity as against debts, may be related to the fact that, on average, for an equal cost of debt and equity, the after tax return on equity is higher than that on debts. This results from a combination of a low levels of corporate tax rates, favourable treatment of dividends with the introduction of the imputation system and low effective capital gains tax rate.

In this chapter, the assumption that firms will always have positive taxable profits against which interests may be deducted is relaxed, instead, the impact of tax exhaustion is analysed. It is hypothesized that, if a company is tax exhausted, then a high level of debts would only entail an increase in risk. Using the pooled cross-sectional time series data we find that the tax position of the firm exerts some influence on its level of debt-capital ratio. The hypothesis that risk and tax shields act at opposite direction on the desired level of debts cannot be rejected. The strength of these results is increased by the similarities in both methods used (OLS and SUR). All the coefficients are significant and of the expected sign. However, when time effect is taken into account, in some years, because of the major changes that have occurred in the tax system or in the level of interest rate, one cannot draw definite conclusions. But the summary statistics confirm the rejection of the hypothesis of any time effect.

The results imply that firms that have losses and/or allowances carry forwards and irrecoverable or unrecovered ACT, are expected to issue less debts. Similarly, the results imply that firms which invest more in plant and machinery than in buildings are likely to issue less debts because of the high allowances offered by the tax system for investment in plant and machinery. This is clearly an important direction for future work.

As opposed to previous empirical studies on the effects of taxation on debt-equity ratio at the aggregate, this study has concentrated more at desegregated level where a number of important variables, such as the effective corporation tax do affect the target debt-capital ratio. Indeed, it could be argued that the tax advantage of debt has been mis-specified by previous studies as the nominal corporate tax rate is assumed to be the effective marginal tax rate for companies.

Moreover, the degree of risk which constraint the firm from increasing indefinitely its debts is measured by beta, the systematic risk that shareholders think the particular company is in. An alternative measure is also tested, being the required premium for risk lenders would expect from the firm to protect them against any loss of funds. This latter is assumed to be incorporated in the interest rate the firm has to pay.

In trying to analyse the effects of taxation on the level of debt-capital ratios, there are some important factors to bear in mind. First, because of the variety of ways in which corporate leverage can be measured, there are a variety of proxies for the target debt-capital ratios of companies, and most important is that answers from these tests may be dependent on the proxy used. There could also be a number of other variables that could help explaining the desired debt-capital ratios and thus could show some contemporaneous covariance amongst all the equations. However, the fact that the adjusted $\bar{R}^2$ is high[15] and the results obtained using both SUR and OLS methods are consistent, point to the fact that these problems did not affect the results.

In the next chapter the effects of taxation on dividends distribution will be analysed, and in chapters 7 and 8 these effects will be related to the investment functions.

15. In general $\bar{R}^2$ is around 70%. King (1977) also found similar R squared, using less number of variables and also with time-series regressions.(King (1977) p.225).

CHAPTER IV

EFFECTS OF TAXATION ON DIVIDEND POLICY

The object of this chapter is to try to analyse the effects of corporation and personal income taxation on the dividend payments of a sample of 109 companies during the period 1972-83. There are a number of reasons for treating the impact of taxation on the dividend distribution in some details. Firstly, economists, in investigating aggregate investment expenditure have examined the relationship between the corporations' retained earnings and their level of investment. A number of empirical studies have found a strong relationship between changes in pay-out ratio and investment policy (Dhrymes and Kurz 1967). Thus, any policy which aims at altering the level of pay-out ratio would automatically have some consequences on the level of investment. One important policy that could play this role is taxes on dividends.

Secondly, the main purpose for changes in corporate tax system is for the authorities to make firms alter their method of financing their projects. As found in the previous chapter, there is a strong relationship between the firm's financing policy and the tax system. If because of the tax exhaustion position debt is no longer a profitable method of finance, the firm is, in theory, expected to reduce its dividend pay-out ratio to finance its investment rather than issue new shares simultaneously as maintaining its level of dividends to reduce its overall tax bill. This brings about the third reason for incorporating this chapter, being why companies pay dividends while investment could be financed cheaply using retained earnings.

The first section lays out some theories of dividend payments in situations where retentions are substantially tax favoured. This is followed by a review of the existing models of dividend behaviour in section 2. Section 3 presents the estimated model and the methodology used is in section 4. In section 5 results are analysed and possible explanations for the effects of taxation are provided. The empirical evidence shows that tax variable does appear to influence the dividend policy of the firm. This analysis is further extended to take possible time effects into account and differences in the econometric model specifications.

1. Theories of Dividend Policy :

A number of theories have been advanced to explain the stability of the dividend pay-out ratio of most companies, observed empirically. The first study by Lintner (1956) based on interviews suggested that managers adjust their pay-out ratios to long-run target levels, while five years latter, Modigliani and Miller (1961) demonstrated that dividend policy of the firm could not affect a firm's total value if capital markets were perfect and there were no taxes. However, the relaxation of these two major assumptions raises new questions as to why companies do pay dividends. In this section, we first look at how taxation affects the decision on whether to distribute or to retain after tax profits before introducing other factors that may influence the distribution.

1.1 Effects of taxation on dividend distribution :

Previous studies on the impact of taxation on dividends using individual company data have examined share price movements around ex-dividend days (Elton and Gluber (1970), Auerbach (1983b), Hess (1982), Litzemberger and Ramaswanmy (1979, 1982), Miller and Scholes (1982), Poterba and Summers (1984)). If marginal investors are untaxed, then changes in dividend taxation would not affect share prices. If, on the other hand, marginal investors are taxed more heavily on dividends that on capital gains, then we would expect share prices to fall by less than the dividend payments. Empirically, the latter situation is observed in most cases, implying that the marginal investors are taxed. Studies that attempted to include personal and corporate taxation into the dividend decisions of the individual company are rare. The present section attempts to find some relationship between the dividend decision, personal income taxation of shareholders and tax position of individual company.

In order to analyse the relationship between taxation and dividend policy one needs to measure the relative tax price of dividend and retentions. King (1977) has defined a tax discrimination variable, θ, as the after tax income which shareholders would receive if the company reduces its retained earnings by one unit, τ the effective corporation tax if the company distributed nothing, and z the effective tax rate on capital gains. If m is the marginal personal income tax rate, then when the firm distributes one unit of dividends shareholder will receive (1-m) under the classical corporation tax system. In an imputation corporate tax system he/she will receive some credit for the corporate taxes already paid on distributed corporate income, and θ will then be equal to (1-m)/(1-s) where s is the rate of imputation. If the imputation rate is equal to shareholder's marginal income tax rate, then no additional tax is paid, thus θ is equal to unity, otherwise the shareholder is taxed at a rate (m-s).

The decision on whether to distribute or retain after tax profits may depend on shareholders' personal income tax rate. If, on the one hand the firm distribute dividends then the amount received increases directly the taxable income of shareholders. If on the other hand profits are retained in the company, they will generate capital gains which, because of the fact that only if these gains exceed a certain amount (e.g. £5000 in U.K. in 1982) that they become taxable and the tax occurs at realisation rather than when the gains accrue, are taxed at lower effective capital gains tax rate. Therefore, basically, shareholder will be better off with dividends if and only if the amount of tax paid on receipt of dividends is lower than that he would pay on capital gains. Since retained earnings yield (1-z) to the investor and distribution yields θ, shareholders are indifferent between retention and distribution only in the exceptional case when $(1-z)=\theta$, as the after tax return is the same .

This traditional view, however, assumes that a unit retention increases the firm's value by one unit. In other words, whether the income is in the hands of the shareholders or invested in the company, the market values both alternatives accordingly, as the information is freely available. Under the U.K. tax system, investors that pay tax are expected to have preferred retention to distribution in the period 1966-73, because of the classical corporation tax operating during that period, and $(1-z)>\theta$. But since 1973, the basic-tax-payer should have preferred dividends to capital gains as

$(1-z)<\theta$ under the imputation system (if z is taken as effective, then the basic tax payer could prefer distributions to retentions). Investors facing higher marginal tax rate may still prefer capital gains to dividends but to a lesser extent than before the changes in the corporation tax system. The following graph shows how the dividend payments by the industrial and commercial companies in the UK has moved from 1963:1 to 1984:4.

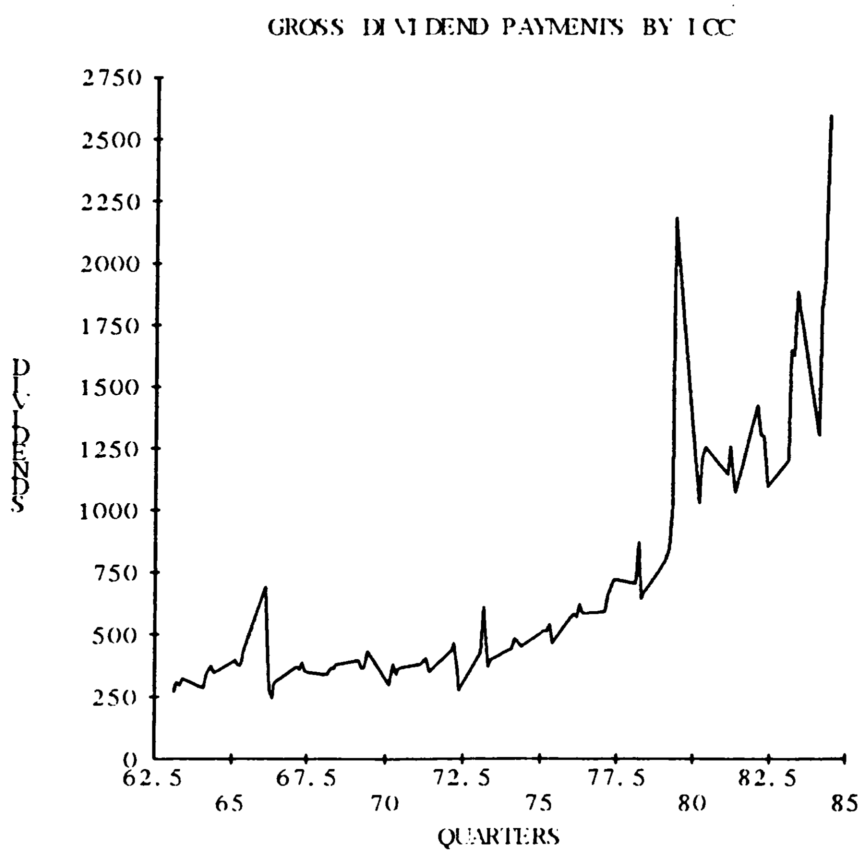

Figure 4.1. Industrial and Commercial Companies dividend payments

There are mainly three sharp discontinuities which may be related to tax changes: first quarter of 1966, second quarter of 1973 and third quarter of 1979. Before the introduction of corporation tax in 1965, dividend received by shareholders were already taxed at standard rate of income tax. This two rate system was retained for the financial year 1965/66. Thus companies have taken advantage of this system by increasing their payment in 1966:1. Under the classical corporation tax system the payment of dividends has been relatively stable (1966:2 to 1973:1). The second major change in the level of dividends paid occurred in the first quarter of 1973 as a result of changes in the corporation tax system. Dividends started rising mainly from 1973, the year of the introduction of the imputation system[1]. There is, finally, another sharp rise in 1979, when, because of the changes in the government, the personal income tax system was reformed, together with the legislation on dividends[2]. Therefore, as the classical theory of dividends distribution would predict, an increase in θ could have led companies, at the aggregate, to increase the level of their dividends payments.

However, this increase in dividends could also be due to the increase in profitability or a rise in the number of companies included in the Industrial and Commercial Companies classification. For the sample of companies studied here the relationship between gross and net dividend pay-out ratio is portrayed in the following graph :

1. Bank of England (1984). Mayer and Meadowcroft (1984) and Williams (1981) found that profits have decreased in the mid of 1970's. As a consequence, the imputation system may have failed to operate to its full extent.
2. The relaxation in dividend control could explain this rapid rise in the amount of dividends paid by Industrial and Commercial Companies (see Bank of England Quarterly Bulletin (1980) for details on the restrictions on payments of dividends.

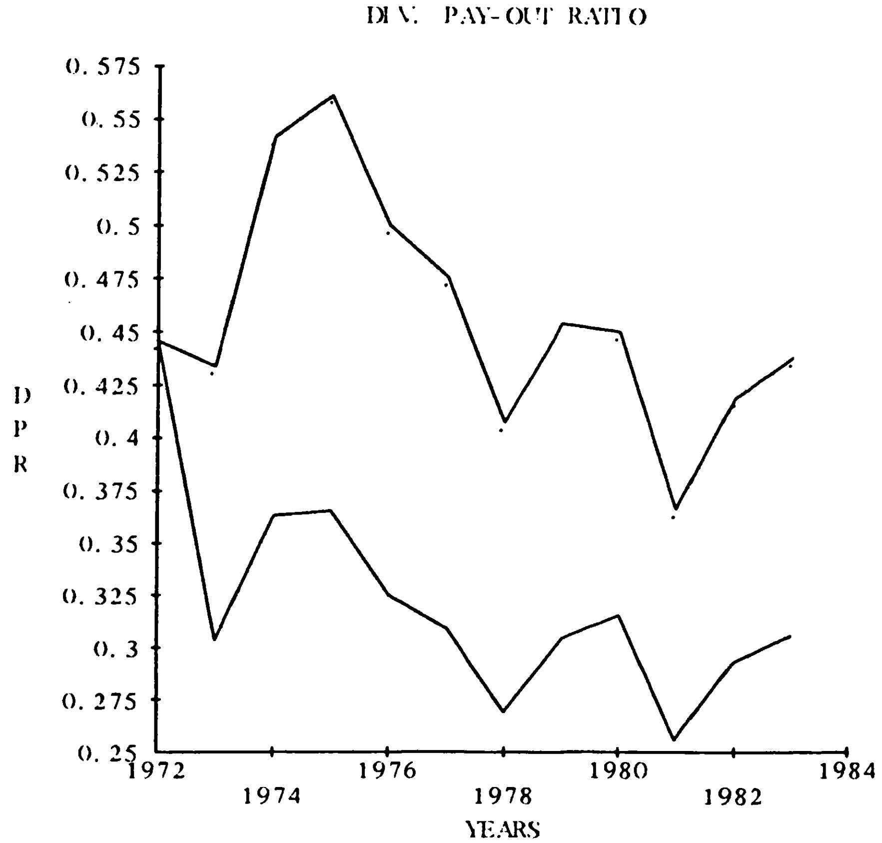

Figure 4.2. Dividend pay-out ratio

Dividends are divided by the sum of dividends distributed and the retained earnings (available for dividends). The dividend pay-out-ratio has remained relatively stable during the sample period for the companies considered. Thus, as opposed to the substantial rise in total dividends paid by industrial and commercial companies at the aggregate, when dividends are expressed in terms of profits one can see that in general companies follow a certain path in the proportion of their distribution. Alternatively, the low dividend pay-out ratios may be the results of the decrease on profitability. Another way of looking at the trends in dividends during the sample period is by plotting the values of dividends per share, a ratio which is not related to profits.

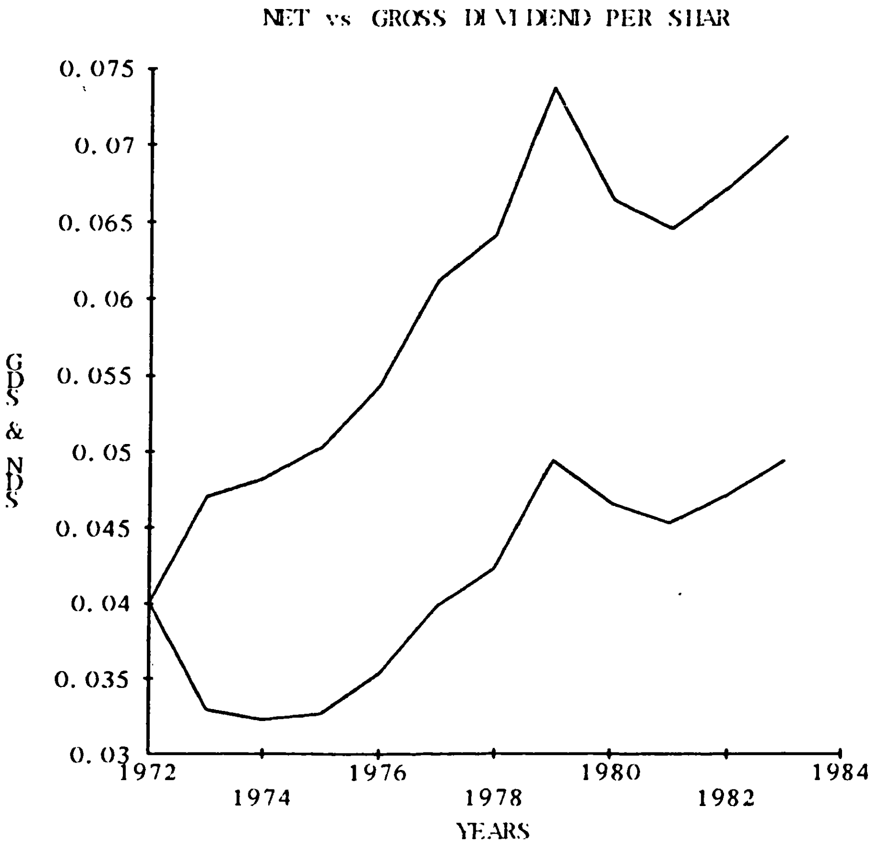

Figure 4.3. Dividend per share

The rapid rise in 1979 is well pictured by this graph and follows exactly the movements in the payments of dividends given by all the Industrial and Commercial Companies (graph 1). Data was not available before 1972, thus a comparison between the classical system and the imputation system cannot be made to a larger extent from this graph. The margin between the two curves represent the effects of the imputation system.

The advantage of this traditional view of dividend policy is that it relates directly tax variables to dividend distribution, and if one includes the uncertainty effects (as discussed below) then it may be possible to explain why do companies distribute dividends. However, it is based on mainly two assumptions. Investors are assumed to be able to sell their shares costlessly, and a unit of retained earnings is assumed to increase the value of the firm by one unit.

If transaction costs were introduced, then the above rule of preferring dividends to retentions applies when $\theta>(1\text{-}z\text{-}c)$ where c represents the rate of transaction costs per unit of share value sold. Dividends, as a direct source of income, eliminates transaction costs which could make the net return from distributing earnings higher than that from retention. However, this argument cannot explain why companies do pay dividends. As King (1977) has showed, the underwriting costs of issuing new shares are substantially higher than investors' costs of selling shares in cases where a firm pays dividends and issues new shares simultaneously. Moreover, if transaction costs are the main determinants of dividend distribution, then one would expect to find two classes of companies, one with zero pay-out ratio owned by investors who derive their income from capital gains, and another who pays dividends, the shares of which are held by investors who want dividends. However, this does not explain the empirical findings that nearly all companies have similar pay-out ratio. Furthermore, transaction costs could be reduced significantly if investors sold shares less frequently.

The second criticism of the above traditional view of dividend policy stems from its assumption that the market values in the same way dividends and retentions, because retentions are used to purchase one unit of new equipment. Thus Tobin's q is equal to 1. This makes θ

and z directly comparable. However, Auerbach (1979), Bradford (1981) and King (1977) (ABK thereafter) have relaxed this assumption and developed a theory, referred to as the tax capitalisation model, in which positive dividend payments are consistent with shareholder asset market equilibrium, precisely because the market value per unit of retained earnings is less than one, i.e. the equilibrium value of Tobin's q is different from unity. If the firm retains one unit of profit, the capital gains will be (1-z)q, instead of just (1-z), where q is the marginal increase in the market value of the firm resulting from a unit of new investment, then shareholders will be indifferent to dividend policy if and only if : $\theta = (1-z)q$ or $q = \theta/(1-z)$. At any other value of q, shareholders would prefer either no dividends or no retentions.

This theory assumes that dividends are residuals. From the funds flow identity, dividends are related to other uses and sources of funds by :

$$D_t = \Delta S_t + \Delta B_t + E_t - \Delta I_t \qquad (4.1.1)$$

Where Δ represents net change, S, B, E, I and D are external equity finance, debt finance, earnings, investment and dividends during the period, respectively.

Dividends are only paid if there is a surplus of funds, i.e. if the right hand side of the above equation (4.1.1) is positive. Therefore changes in dividend taxes would not have direct effects on investment decision of the firm, and dividends are expected to vary according to the investment opportunities of the firm.

Moreover, this view implies that dividends are the only mean for a company to transfer money to its shareholders. The market value of corporate assets is equal to the present value of the after-tax dividends which firms are expected to pay. In reality, however, companies can increase the income of their shareholders through share repurchases[3], takeovers and purchasing shares in other companies.

This theory also always assumes that $q<1$, this is thus incompatible when $q \geqslant 1$ as is the case for some investors during the imputation system. Furthermore, the capitalisation view implies that, so long as $q<1$ then firms would never issue new shares and pay dividends simultaneously. However, recently Edwards (1984a) reported that 25% of a sample of large British companies paid dividends and issued new equity in the same year, while 17% , not only paid dividends but raised their dividends during years when they issued new shares.

ABK theory assumed explicitly that all investors have the same tax rates θ and z in any company to have the same preferences. This causes the market segmentation of firms depending on whether they pay no dividends or have no retained earnings. However, as Feldstein and Green (1983) have argued, even if companies set their financial policies to cater for the differences in shareholders' tax rates, investors may be willing to diversify their portfolio from companies that grow faster as a result of high retained earnings to the other

3. In some countries, such as the U.S., companies can repurchase their own shares. However in the UK Section 55 of the Companies Act 1948 precludes share repurchases. The Companies Act 1981 Sections 53-60 introduced, however, a system whereby a limited company can buy back its own shares out of distributable profits or proceeds from new shares issue but there are a number of restrictive rules to be compiled with before payments by a company to repurchase its own shares can be exempted from treatment as distribution.

which distribute dividends. This is because there is an uncertainty in the realisation of capital gains.

Another explanation of dividend distribution is that of Miller and Scholes (1978). They argued that the marginal investor in corporate equities is effectively untaxed on both dividends and capital gains income because of the number of allowances offered by the tax system. Under the US tax law, an individual's deduction for investment interest, in addition to mortgage and business interest, is limited to investment income plus 10,000 Dollars. The allowable interest deduction is raised by one unit for each extra unit of dividend income[4]. If this constraint is binding, then the taxable income remains unchanged because an extra unit of dividends is just offset by the extra unit of interest deduction. Alternatively, this marginal investor could be an institutional investor for whom the marginal personal income tax rate and the effective corporation tax rate are both zero. Therefore dividends are not affected by taxation. Under this tax irrelevance view, investment is independent of the dividend pay-out ratio and this leads to the Miller and Modigliani (1961) irrelevance theory. However, when this theory is tested empirically, Feenburg (1981) found that in 1977 only 2.5% of dividend income is actually received by shareholders for whom this constraint is binding[5].

4. The US tax code allows the *accumulator* investors to set up some strategies to avoid the income tax on dividends by borrwing to generate interests which offset dividend income and by offsetting the high risk associated with this levered position by tax deferred lending such as purchasing life insurance.

5. Litzemberger and Ramaswany (1982) have shown that, in order for a non-accumulator not to hold shares at all, the after-tax expected rate of return on shares must be less than the after-tax rate of interest.

Poterba and Summers (1983, 1985) compared these different hypotheses about dividend payment. Using time series aggregate dividends paid by the industrial and commercial companies as a proportion of the maximum dividend the firm could pay during the period 1955 to 1983, they find that companies take account of their dividend taxes in determining the extent to which their after tax profit is distributed. Tax policy changes induce short and long-run adjustments in the dividend pay-out ratio. Moreover, applying the investment rate to an alternative definition of the Tobin tax adjusted Q, they find that the specification of Q without the capitalisation effect explains better the investment behaviour.

So far a company is always assumed to be able to recover the advanced corporation tax it pays when it distributes dividends, i.e, that the imputation system is fully operational. As analysed in chapter two, many companies are tax exhausted before allowing for the imputation rate. This makes many companies unable to claim the advanced corporation tax rate during the payment period. Moreover, given that during the sample period ACT can be carried back to two years or forward and that the amount of ACT must not be higher that 30 per cent of the taxable profit in any given year, these companies may not be able to recover the ACT at all. In this case the firm will be as if it is operating under the classical corporation tax system where it may not be encouraged to distribute dividends. Fung and Theobald (1984) argued that this limitation on recovery is expected to induce a negative effect on dividends. Edwards *and al.* (1985) found that when a correction for the unrecovered ACT is made in their dividend model, the influence of taxation on dividend setting is increased. Studies that have used aggregate data cannot account for this possibility.

1.2 Uncertainty effects in dividend policy :

Taxation on its own would not explain dividend distribution. If that was the case then one would expect takeovers to be based solely on the changes in the financial policy[6]. If shareholders consider only tax variables in chosing their investment, then a takeover raider is likely to purchase the dividend paying company, change its financial policy and sell it at a large premium. However, in practice this is not the case, and there are a number of other consideration which should be included in any dividend policy model in order to undertake an empirical analysis of dividend distribution. The present section reviews briefly the main theories that have been advocated previously to explain why companies do pay dividends albeit the tax disadvantages of such policy.

One of the most popular argument given for dividend distribution is based on the fact that shareholders and managers have differential information, arising from the separation of ownership and control. Dividends act as a signal of the information possessed by managers on the company future investment and future profit opportunities which is unknown to the shareholders (see for example Ross (1977) , Bhattacharya (1979) and Edwards (1981)).

6. There are other motives for merger activity encouraged by taxation, such as combined interest deductions. Smirlock, Beatty, and Majd (1985) offer a survey of such tax motivated merger activities.

Given that the information transfer is very important under this theory, then it is possible to find companies issuing new equity in the same time as paying dividends. Under imperfect capital markets, one of the only ways a shareholder can know whether the company is prosperous or not is by looking at how much the company distributes as dividends. Thus one would expect a positive relationship between the dividend distribution and the level of investment undertaken by a company, because the more the company is prosperous, i.e. the more it is likely to generate higher profits in the future, the higher the dividend payments. However, in theory, companies which have many opportunities in terms of present investments are likely to have greater demand for internal funds and not distribute them as dividends (Edwards 1981). Moreover, if the purpose of dividends is just communicating information, it is hard to imagine why companies do not use other means, such as disclosing more details on their investment plans to make shareholders more confident about the prospects of the company.

A closely related explanation of dividend distribution to this signalling argument is the "Bird in Hand" theory developed by Wood (1975). He argued that investors prefer the certainty of dividends to the uncertainty of capital gains. He stated that :

"Dividends, by putting cash into the shareholders' hands, enter a benefit on him which is certain and tangible in a sense in which retained earnings, however lucratively invested, do not"

He argues that, because shares are traded in a wide volatile and uncertain market, investors cannot predict their income from capital gains, and not because the company's investment and future profits are uncertain. It is observable that share prices exhibit some large fluctuations, but it may be that these fluctuations are somewhat around the mean and the actual relationship between dividend and share prices cannot be said to be completely irrelevant.

An alternative explanation of dividend distribution relies on the view that management uses retained earnings not efficiently. In this case, dividends act as a mean to reduce the scope for management to undertake unprofitable investment projects. A number of empirical studies support the view that retained earnings are used inefficiently. Rayner and Little (1966) found evidence, using a sample of British companies, that the rate of return on projects financed from retentions is typically well below that of externally financed projects. Similar results were reported by Baumol, Heim, Malkiel and Quandt (1970) for the US. The former study tried to analyse what influences size of the firm and the amount of retained earnings had on growth of earnings per share. The coefficient of the proportion of the retained earnings is found to be insignificant and with the wrong sign when it is regressed against the increase in pre-tax earnings from 1958 to 1959.

These studies relate directly investment decision to dividend distribution. They show that retentions are used to finance less profitable investment projects and that debt is maintained at a level where its marginal cost is equal to that of retentions. Baumol *et al.* (1970) found that the rate of return on retentions debt and equity capital are in the range of 3.0-4.6%, 4.2-14% and 14.5-20.8% respectively.

However there are some considerations to take into account when interpreting these results. The results of the former study (Rayner and Little 1966) may be due to the short sample period used (i.e. one year). The average return is also assumed to be the same for all the companies studied. Furthermore, the figure given by Baumol *et al.* (1970) may concern only these companies studies, the time period when this study has been done and the country or the area in which it has taken place. The econometric specification of these studies also need a careful examination as it includes some arbitrary assumptions. Baumol *et al.* (1970) did not test for the statistical significance of the differences in projects returns and there were no corrections for the riskiness of the projects studied. Their empirical findings could be due to the fact that they considered only the first few years of a project's lifetime. They also did not correct for the heteroscedasticity. Thus, although the OLS coefficients estimates are unbiased, the estimates of the variance of the coefficients is likely to be biased, which could make them unsignificant. Brealey, Hodges and Capron (1976) found strong evidence of the presence of heteroscedasticity. When it is taken into account the estimated rate of return on retention is lower than that of the two other alternatives sources of finance, but the difference between the estimated rates of return is not generally statistically significant.

This brief review of the theories of dividend policy does not however provide a straight answer to why companies pay dividends. In the next section the existing models of dividend behaviour are reviewed to see how the tax variable affects dividend distribution.

2. Models of Dividend Policy :

Almost all econometric models that tried to analyse the effects of taxation on dividend behaviour have used aggregate data. They are all based on the standard partial adjustment model proposed by Lintner (1956) which is derived from an empirical generalisation of the results of interviews of 28 US companies. He argued that companies determine desired dividends in any period by relating a target pay-out ratio r (function of some specific characteristics of the firm) to current reported earnings, i.e.

$$D_t^* = rE_t + \epsilon_t \tag{4.2.1}$$

The actual dividends in one year, D_t, are then adjusted by some constant fraction λ of the difference between this period's desired dividends and the previous period actual dividend payments, D_{t-1}, by:

$$D_t - D_{t-1} = \lambda[D_t^* - D_{t-1}] + v_t \qquad 0<\lambda<1. \tag{4.2.2}$$

Combining equations (4.2.1) and (4.2.2) and adding the constant term to reflect the reluctance of the firm to pay negative dividends yields :

$$D_t = \alpha_0 + \alpha_1 E_t + \alpha_2 D_{t-1} + \mu_t. \tag{4.2.3}$$

Where : $\alpha_1 = \lambda r$; $\alpha_2 = (1-\lambda)$; $\mu_t = \epsilon_t + v_t$

Feldstein (1970, 1972) was the first to estimate such an econometric model of dividend behaviour by including a tax variable as a regressor. He used quarterly data of aggregate companies from 1953 to 1964. He concluded that the long run elasticity of dividend pay-out with respect to the tax price of dividends was about 0.9. King (1972b, 1977), on the other hand, found a smaller tax elasticity (0.4) when annual data for the period 1950-72 is used with explicit managerial preferences. Nevertheless, they both found that differential taxation affects dividend policy of the firms at the aggregate.

In order to test for the tax effects, Feldstein and King defined a variable θ to measure the opportunity cost of retained earnings in terms of net or gross dividends[7] foregone. Equation (4.2.1) becomes :

$$D_t^* = AE_t^{\alpha}\theta_t^{\beta}U_t \qquad (4.2.4)$$

Because of the delayed response to raise dividends with a rise in profits, the actual dividends are assumed to adjust according to :

$$\frac{D_t}{D_{t-1}} = [\frac{D_t^*}{D_{t-1}}]^{\lambda} V_t \qquad (4.2.5)$$

Then the estimated equation is derived by combining equations (4.2.4) and (4.2.5) and by using logarithms as follows :

$$\ln D_t = \lambda lnA + \lambda\alpha lnE_t + (1-\lambda)lnD_{t-1} + \lambda\beta ln\,\theta_t + \mu_t. \qquad (4.2.6)$$

Fane (1975) estimated a linear dividend equation and allowed for specific timing effects of tax changes. He argued that, ignoring the timing effects, leads to serious over-estimation of the long-run impact on dividends of changes in the relative rates of tax on distributed and undistributed profits, the reason why, he argues, that the estimates of Feldstein and King of tax price elasticities are biased away from zero. However, no elasticity calculations were reported. Moreover, it is difficult to compare his results to those of Feldstein and King because his equation did not involve logarithms.

There are a number of reservations when interpreting the results

7. The difference between the two is explained below. Basically, if θ is defined in terms of gross dividends then the marginal personal income tax of shareholders is not taken into account.

obtained by either using equations of the form (4.2.3) or (4.2.6). The main problem is that the estimated equations show some residual autocorrelation in the error term μ_t, and since they performed time-series regressions, this problem could bias the results. Feldstein and Fane attempted to use autoregressive least squares by adding μ_{t-1} and μ_{t-4} to their specification (equations (4.2.6) and (4.2.3) respectively). King (1977), on the other hand, imposed an ARMA(1,1) error structure on the residuals and estimated his model by maximum likelihood.

Furthermore, because of the fact that the partial adjustment model is not firmly grounded in the optimising decisions of rational agents, the results of estimating it are open to different interpretations (Edwards 1981). However, the basis of such model can still be regarded as constituting a theory because Lintner derived it from his field work, involving detailed study on how the companies have made their dividend decision, and not just because it fitted the data.

The most important problem with the above studies is perhaps the fact that they were all done prior to the major change in corporate taxation, being the introduction of the imputation system in 1973. Thus the effects of the imputation rate are not analysed. Poterba (1982) reestimated King's model by including the post 1973 period. He found that the tax variable, θ, had a sizable coefficient and significant for the early sample (1951-72) and (1951-69), but in the full sample when the imputation system was in effect, (1951-80) and the 1960-80 period the coefficient of this tax variable is insignificant. The parameters of Feldstein and King dividend model were not stationary during the post-war period. In addition he found that the error structure dynamics have changed in important ways. However, Poterba and Summers (1985) have estimated a similar equation but by redefining θ[8] and profit[9]. Using OLS with a maximum likelihood correction for second order serial correlation, they found that the long-run dividend payments elasticities with respect to the total tax preference ratio is between 2.6 and 1.8 depending on specification and time period chosen. But when changes in θ_t and θ_{t+1} are included this elasticity decreases slightly.

King (1977) has defined θ in terms of gross rather than net dividends foregone. In doing so, he did not include the marginal personal income tax rate of shareholders. The relationship between θ and $\hat{\theta}$ which he used is simply $\theta=(1-m)\hat{\theta}$ where m is the marginal personal income tax rate faced by shareholders. Clearly, this specification is only suitable if one uses time-series data, unless if effective advance corporation tax for instance is used, as opposed to the statutory tax that cross-sectional regressions may be performed. At company level, Edwards (1981) defined in the same way as King his tax variable when he estimated the linear dividend equation for a sample of 119 UK companies over the period 1955-72. His results, however, do not support the view that changes in the degree of tax discrimination have significant effects on dividend payments.

The above studies have mainly analysed the effects of taxation on dividend distribution by taking aggregate, rather than individual

8. θ is defined in terms of capital gains. It is equal to $\frac{(1-m)}{(1-s)(1-z)}$.

9. Profit is defined as the maximum feasible gross dividends of the firm

company, data in their tests[10], and this could raise the problem of the aggregation bias. Moreover, computing the tax discrimination variable, θ, just on the basis of the average tax rate of all the shareholders in the economy does not provide any information on how firms actually do make their dividend decisions. Given the numerous characteristics that distinguish one firm from another, it is important to analyse the effects of taxation on individual company rather than at the aggregate. This provides a warrant for further empirical investigation of the effects of taxation at individual firm's level. This is the main concern of the following section.

3. Formulation of the Model of Dividend Policy :

The aim of this test is to analyse the variables that could explain the distribution of dividends. The concern of this research is mainly with the tax effects, but other factors do influence the firm's dividend policy and the failure to take them into account when estimating a dividend equation could result in an inadequate representation.

3.1 Model formulation :

The above review of the literature revealed that there is no *a priori* theory behind the models of dividend policy. The present study does not intend to find one, but rather extend the existing models to find the influence of taxation on dividend distribution on a number of companies. The Lintner (1956) specification is followed. It is

10. Fama and Babiak (1968) used individual firm data. However, their estimated equation is slightly different from the Lintner model as it includes a lagged profit and it did not include any tax effects.

assumed that the level of dividend of a particular company at a particular time is a function of the profits and lagged dividends in a stock adjustment equation.

In order to test for whether changes in the relative tax treatment of dividends and retentions affect the long-run pay-out ratio, previous studies have stipulated that dividends are related to normal earnings by a ratio which depends on the opportunity cost of retained profits in terms of net dividend foregone. Thus :

$D_t = f(\theta_t, TAX_t, EPS_t)$.

Where θ defined as the ratio of $(1-m)/(1-s)$, is expected to have a positive effect on dividends distributions because a rise in θ corresponds to a reduction in the tax discrimination against the payment of dividends. TAX_t which defines companies that are tax exhausted, on the other hand, would have a negative impact on the distribution of dividends, because if the firm is tax exhausted then it may not be able to recover its ACT. Following Feldstein (1970, 1972) and King (1977), this model is supposed to be estimated in log linear form. However, given that a substantial number of firms had zero dividends or a negative earnings per share for at least one year in the sample period, the log linear form of this model reduces substantially the number of observations, and thus it is rejected. The linear form is, therefore, used to estimate the dividend model by adding the tax discrimination variable as an additional regressor. Fane (1975) used similar specification in his study of the quarterly aggregate dividend payments in the UK. We assume that the desired dividends were determined by :

$D_t^* = \beta EPS_t + \gamma\theta_t + \delta TAX_t.$ (4.3.1)

This equilibrium means that, when it is achieved, the firm would not be willing to change its dividends payments unless some of the exogenous variables have changed. The actual dividend payment at time t adjust according to :

$D_t - D_{t-1} = \alpha + \lambda[D_t^* - D_{t-1}] + v_t$ (4.3.2)

Where α is introduced to constrain firms from reducing their dividends. By combining equations (4.3.1) and (4.3.2) we can obtain :

$D_t = \alpha + \lambda\beta EPS_t + \lambda\gamma\theta_t + \lambda\delta TAX_t + (1-\lambda)D_{t-1} + v_t$ (4.3.2)

This equation is used in this study to investigate the effects of differential personal taxation and corporate taxation on dividends at the individual company level. Defining :

$\beta_1 = \lambda\beta$; $\beta_2 = (1-\lambda)$; $\beta_3 = \lambda y$ and $\beta_4 = \lambda\delta$

the estimated equation becomes :

$NDS_{t,i} = \beta_0 + \beta_1 EPS_{t,i} + \beta_2 NDS_{t-1,i} + \beta_3\theta_{t,i} + \beta_4 TAX_{t,i}$ (4.3.3)

Where NDS_{t_i} is the net dividend per share of company i at time t;

$EPS_{t,i}$ represent the earnings per share of firm i at time t;

$TAX_{t,i}$ = dummy variable to measure the possibility that a company may not recover its ACT.

The coefficients β_1, β_2 and β_3 are all expected to be positive, while the coefficient β_4 is expected to come with a negative sign.

3.2 Definition and estimation of the variables:

The definition of the tax discrimination variable used in this study is the same as that used by Fane. It is the opportunity cost of retentions in terms of *net* dividend foregone. θ is thus a function of the average marginal personal income tax of shareholder, computed as follows.

As it is extremely difficult to find exactly not only the composition of the different shareholders of each company, but also their respective holdings, the computation of the tax discrimination variable necessitates a number of assumptions about the personal income taxation of the different shareholders. There are three main problems involved in this computation. The categorisation of shareholders for each company, the computation of the average marginal personal income tax for each category, and also the holding of each category. As far as the first problem is concerned, we follow King (1977) in dividing the total shareholders into three categories according to their position towards income tax :

a) Persons: This category includes individuals as well as unit and investment trusts because investments through these intermediaries do not affect the ultimate tax burden born by investors.

b) Insurance companies: They are taxed using a special rate.

c) Pension funds and charities: They are exempt from tax[11] thus their income tax is zero.

The main problem lies in the computation of the average personal income tax rate for the first category. The average for all persons is computed from the *Inland Revenue Statistics* . Orhnial and Foldes (1975) assumed that income is distributed according to the a Pareto

11. King and Fullerton (1984), showed that this category's personal income tax rate is in effect negative rather than zero. It is assumed here, however, that it is zero.

distribution. The data provided by the *Inland Revenue Statistics* cannot be used directly as the distributions given are either by assessed income only or by total income. In order to obtain the relationship between the two distributions, Orhnial and Foldes (1975) assumed that income is distributed according to a Pareto distribution where a straight line can be obtained if the logarithm of income is plotted against the logarithm of total number of people with income in excess of each level of income. In this way, the level of net income

th and also the tax thresholds for each band can be expressed in terms of

and also the tax thresholds for each band can be expressed in terms of

total net income. The marginal tax rates on dividends and interest can therefore be calculated as the weighted average of the marginal tax rates with weights given by the proportion of dividend income respectively accruing to recipients in each tax bracket.

Thus after this categorisation of shareholders and the computation of the average tax rate for each category, we need now the proportion of holdings of each category in each company. The major problem is the lack of information on the such holdings. The Stock Exchange (1982) provides a general description of the holdings of each category for all the firms in the stock market from 1963 to 1981. This information, together with some publications of the holdings in some companies' accounts provide a useful way of computing the average personal income tax rate for all the companies studied. However, if this average is used for each company, then the tax discrimination variable would not have any explanation, as it will be neglected by the regression in cross-sectional. It is thus necessary to find something that distinguishes one company from another.

One of the important difference considered here, is the interest of the directors. Given that it is them who make the financial decision of the firm we would expect them to consider their tax position as the main determinant for the distribution or retention. Data on these holdings is taken from the Extel cards and from Datastream. However, since this data is only available for 1980-1983, the average holdings for these 4 years is assumed for all the sample period. This assumption may not be restrictive, given the fact that shareholders make the decision on whether to hold or to sell their shares. So it is make the decision on whether to hold or to sell their shares. So it is assumed that the directors do not change their holdings very often.

From a number of companies' accounts and from the Extel cards, it was found that in general the salary of the directors is on average twice as much as the highest tax bracket. The average marginal income tax rate of directors is computed using the statutory rate for each year to their average earnings. For each company, the average income tax rate of the shareholders is calculated as :

$$m_{t,i} = DIR_i * HR_t + (1 - DIR_i)AR_t$$

Where DIR_i is the % of directors interests in each company i;

HR_t is the higher rate of income tax for each period t;

AR_t is the average rate of personal income tax rate.

The tax discrimination variable, θ, is therefore computed as :

$$\theta_{t,i} = \frac{(1 - m_{i,t})}{(1 - c_t)}$$

Where c is the standard imputation rate, equals to zero for 1972.

The tax variable is computed as a dummy variable equals to unity if the company's taxable profit is zero or negative before allowing for

ACT, and equal to zero otherwise.

Given that our sample covers the period of the imputation system, there is no need to define the dependent variable in terms of gross dividends. Moreover, since the tax discrimination variable relates to the actual dividend received by the shareholder, the use of gross dividends as a dependent variable may lead to a mis-specification of the model. The use of dividend per share as against dividend pay-out ratio avoids the problem of double counting of the imputation rate, because after tax profits depend on the firm's pay-out policy when the imputation system is in effect. The number of shares for each company is obtained from Datastream and Extel Cards.

4. Methodology :

The above equation (4.3.3) is estimated using two econometric specifications : seemingly unrelated regressions (SUR) and the ordinarily least squares (OLS). It is likely that since the data is both cross-sectional and time series, the coefficients that will be obtained may be biased. Indeed dealing with pooled data creates problems of heteroscedasticity and contemporaneous covariance. The former problem arises because of the large differences in the firms' sizes. Thus, a company that has lower dividends does not mean necessarily that it has higher retained profits. This bias will mainly be seen in the residuals which will not have a common variance. This makes some coefficients appear to be significant while in reality they may not be. In order to correct for this problem, all the variables are taken as ratios (Maddala (1977) p.93) by dividing them by the total number of shares. Profits are not taken as a common denominator because of the fact that one of the explanatory variable is already profit. Logs could also be used to correct for the heteroscedasticity, but, as Maddala (1977) pointed out, this will result in giving undue weight to the large observations.

The problem of contemporaneous covariance is likely to arise because of the possibility of the existence of a correlation between different disturbances in different equations, which at a given point in time are likely to reflect some common unmeasurable or omitted factors. Since Lintner's model is based just on interview, one cannot rule out the possibility that some other factors which could influence dividend behaviour were not mentioned in the interviews but which could be important in other countries or in other periods (King (1977) p.171). Furthermore, during the sample period dividend control has been in effect in some years and this could have had same effect on all the firms in the sample. A dummy variable for such restriction could have been defined but would not be taken into account in cross-sectional regressions. It is therefore necessary to try another specification other than OLS. SUR helps in dealing with problems because it splits the data into a set of regression equations. It consists of time series observations on a number of cross-sectional firms and it allows each cross-sectional company to be described by one equation from the system. Nevertheless, the results obtained from both methods, OLS and SUR, are presented to allow for comparisons to be made. Given the short time period in the sample (12 years), the concentration is more on the variability across companies rather than across time. SUR is preferred to alternative specification because using the random coefficient estimator would worsen the problem associated with the inclusion of the lagged dependent variable.

5. Results of Estimating Dividend Equation :

The following table (4.1) reports the results obtained when equation (4.3.3) was estimated for the pooled cross-sectional and time series data, using both econometric specifications, SUR and OLS.

TABLE 4.1. RESULTS SUMMARY OF ESTIMATING DIVIDEND EQUATION: POOLED

$$NDS_{t,i} = \alpha + \beta_1 EPS_{t,i} + \beta_2 NDS_{t-1,i} + \beta_3 \theta_{t,i} + \beta_4 TAX_{t,i}$$

	COEFFICIENTS α	β_1	β_2	β_3	β_4	$\bar{R}^2$	σ	T.M.
OLS								
(1)	0.03	0.088				0.316	0.033	
	(27.62)	(22.77)						
(2)	0.003	-	0.95	-	-	0.827	0.016	
	(4.11)		(73.16)					
(3)	-0.04	-	-	0.093	-	0.042	0.040	
	(-3.32)			(7.09)				
(4)	0.043	-	-	-	-0.01	0.013	0.036	
	(37.29)				(-4.16)			
(5)	-0.05	0.088	-	0.09	-	0.359	0.032	
	(-5.32)	(23.54)		(8.71)				
(6)	-0.011	-	0.940	0.017	-	0.828	0.016	
	(-2.42)		(71.58)	(3.09)				
(7)	-0.018	0.033	0.84	0.026	-	0.863	0.015	
	(-4.34)	(16.95)	(64.22)	(5.05)				
(8)	-0.018	0.048	0.816	0.025	-0.002	0.875	0.013	
	(-4.97)	(19.53)	(64.71)	(5.63)	(-2.10)			
SUR	-0.015	0.036	0.840	0.021	-			1113.6
	(-5.31)	(21.21)	(76.54)	(5.84)				
	-0.015	0.036	0.840	0.022	-0.002			1113.8
	(-5.29)	(21.29)	(76.81)	(5.98)	(-2.45)			

Notes : t-statistics in brackets; $t_c = 1.960$ at 5% level;

T.M. = trace matrix obtained from the SUR; $\bar{R}^2$ = adjusted coefficient of determination;

σ = standard error of the estimates; Number of observations = 1122.

The signs of the estimated coefficients satisfy all prior expectations. All coefficients in table 4.1 are assumed to remain the same through time, thus only company effects are captured. The evidence shows clearly that whatever method of estimation employed, the tax discrimination variable θ, is always significant and with the expected sign. This means that a reduction in the average marginal personal income tax rate by 10% would result in an increase in dividends by 0.2%. In the long-run an increase in the imputation rate, for instance, by 10% would result in an increase in dividends by 1.37 per cent. Moreover, the results imply that if the company is tax exhausted, then it pays lower dividends, because of the possibility that the advanced corporation tax may not be recovered. Therefore the hypothesis that taxation does not influence the firm's dividend policy can be rejected.

The other explanatory variables are also significant and with the expected sign. There is a strong similarity between the two specifications in the size of the coefficients and the level of their significance. From the coefficient of the earnings per share we can say that a rise by one unit in the profit of the firm would have as an immediate consequence an increase of 0.036 to 0.049 units in the level of dividends paid by the firm. In the long-run the same increase in profit would result in a rise of between 0.266 and 0.225 units in the level of dividends depending on which econometric method used. This is quite consistent with the average dividend pay-out ratio for the whole sample of around 0.29.

These results seem to contradict the comments made by Whittington (1971) on Feldstein's original paper, on the interpretation of a significant positive coefficient of the tax discrimination variable. He pointed out that a change in the tax system which increased the differential taxation of dividend, thus lowering θ, would involve a redistribution of post tax income from companies with relatively high pay-out ratios to ones with relatively low pay-out ratios, and hence this income distribution effect would result in lower aggregate dividend even if, for some unexplained reasons, individual companies did not change their desired pay-out ratios. In fact, these results presented here point to the opposite. They do, in general, support the macro-economics evidence of the effects of taxation on dividend distribution.

There may, however, be a possibility of a presence of linear relationship among explanatory variables, and as a result the above estimates of the coefficients may be indeterminate and the standard errors of these estimates could be infinitely large. In order to test for the absence of multicollinearity, a method based on Frisch's Confluence Analysis is employed. (Koutsoyiannis (1977) pp.233-257). It involves regressing the dependent variable on each one of the explanatory variables separately. Then gradually additional variables are inserted and their effects on the individual coefficients, on their standard errors and on the overall $\bar{R}^2$ are examined. If the coefficients are affected by the introduction of the new variable in such a way as to become unacceptable (wrong sign or decreases the significance of coefficients or reduces significantly the $\bar{R}^2$), then multicollinearity is a serious problem. This is done in equation (1) through to equation (8) in table 4.1.

Comparing equations (1) to (7) with equation (8) we can see that the best fit is obtained when all the variables are included in the equation in terms of high $\bar{R}^2$ and low standard error of the regression.

Moreover, in table (4.1) each time a new variable is introduced, the $\bar{R}^2$ increases together with the significance of the coefficients of the previous variables, and are all of the correct sign. The standard error is lower in equation 8. This shows that the effects of multicollinearity is not serious for β_1 and β_2. The simple correlation between the earnings per share in the period and the dividend per share during the previous period is (0.436).

It is also worth noting that the constant, α, becomes negative only when the tax variable, θ, is introduced (equations 3,5,6,7 and 8). There could be a trade-off, as far as the tax is concerned, in which a company is indifferent between paying dividends and retaining earnings. This breaking point is obtained when θ is equal to 0.43 (from equation 3). Assuming the average imputation rate for the period to be 0.30, then the firm will be indifferent between paying dividends and retaining earnings if the marginal personal income tax rate of the shareholders is equal to 0.70. In other words, firms that in the sample would not have paid any dividends if the average personal income tax of their shareholders has been greater than 0.70. However, the mean of m during the sample period is 0.44, this gives an average of θ of around 0.81. If the imputation system was not in operation, we would expect firm not to pay dividends if the marginal personal income tax rate of the shareholders is 57%. Therefore the existence of the imputation system has a significant effect on the distribution of dividends as it rises the breaking point of average personal income tax at which firms pay dividends.

The above method, however, did not take account of the possible time effects in the dividend policy. It is assumed that the coefficients remain constant through time, and that dividends and the explanatory variables did not change significantly during the 11 year period of analysis. In order to relax this assumption, equation (4.3.3) is re-estimated for each year from 1973 to 1983. The results of such exercise are presented in the following tables (4.2 and 4.3).

TABLE 4.2. RESULTS OF CROSS-SECTIONAL REGRESSIONS DIVIDENDS EQUATION: SUR

$$NDS_i = \alpha + \beta_1 EPS_i + \beta_2 NDS_{-1,i} + \beta_3 \theta_i + \beta_4 TAX_i$$

YEARS	COEFFICIENTS						
	α	β_1	β_2	β_3	β_4	σ_u σ_r	$F_{5,97}$
1973	-0.006	0.021*	0.79*	0.007	0.00006	0.008	13.24**
	(-1.37)	(2.06)	(25.15)	(1.09)	(0.035)	0.010	
1974	0.005	0.012*	0.875*	-0.003	-0.0004	0.007	7.36**
	(0.52)	(2.42)	(28.72)	(-0.29)	(-0.28)	0.009	
1975	-0.005	0.038*	0.893*	0.0074	-0.004*	0.009	1.345
	(-0.55)	(5.13)	(24.6)	(0.66)	(-2.52)	0.009	
1976	-0.006	0.008	1.09*	0.006	-0.002	0.007	17.53**
	(-0.86)	(1.65)	(42.97)	(0.75)	(-1.18)	0.010	
1977	-0.018*	0.032*	1.02*	0.02	0.003	0.010	9.40**
	(-2.00)	(6.10)	(35.0)	(1.84)	(1.54)	0.012	
1978	-0.020	0.04*	0.97*	0.017	0.005	0.009	7.32**
	(-1.98)	(11.29)	(38.3)	(1.81)	(0.26)	0.010	
1979	0.008	0.022*	1.04*	-0.005	-0.002	0.011	12.83**
	(0.78)	(6.20)	(35.13)	(-0.42)	(-1.03)	0.015	
1980	-0.07	0.087*	0.64*	0.086	0.001	0.024	3.93**
	(-1.41)	(8.41)	(11.48)	(1.47)	(0.25)	0.027	
1981	-0.070*	0.045*	0.780*	0.089*	-0.005	0.014	0.500
	(-2.04)	(9.17)	(21.4)	(2.17)	(-1.85)	0.014	
1982	-0.030	0.040*	0.665*	0.050	-0.007	0.019	2.010
	(-0.74)	(8.07)	(13.19)	(1.02)	(-1.73)	0.021	
1983	-0.023	0.040*	0.770*	0.040	-0.005	0.013	0.895
	(-0.87)	(8.64)	(23.63)	(1.18)	(-1.85)	0.013	

Notes: t-statistics in brackets;

* significant at 5% level, t_c = 1.960 (two-tail test);

σ_u = standard error of cross-sectional estimates;

σ_r = standard error of pooled estimates;

** Chow test, significant at 5% level, $F_{5,97}$ = 2.37.

Trace matrix = 1101.23.

Number of observations = 102.

TABLE 4.3. RESULTS OF CROSS SECTIONAL REGRESSIONS DIVIDENDS EQUATION: OLS

$$NDS_i = \alpha + \beta_1 EPS_i + \beta_2 NDS_{-1,i} + \beta_3\theta_i + \beta_4 TAX_i$$

YEARS	COEFFICIENTS						
	α	β_1	β_2	β_3	β_4	$\overline{R}^2$	σ
1973	-0.006	0.010	0.823*	0.006	0.00003	0.925	0.008
	(-1.19)	(0.93)	(23.92)	(0.90)	(0.02)		
1974	0.005	0.009	0.864*	-0.003	0.0002	0.926	0.007
	(0.50)	(1.70)	(25.68)	(-0.22)	(0.12)		
1975	-0.006	0.050*	0.850*	0.010	-0.005*	0.904	0.009
	(-0.70)	(5.09)	(19.45)	(0.87)	(-2.57)		
1976	-0.006	0.008	1.060*	0.008	-0.002	0.946	0.008
	(-0.89)	(1.43)	(39.51)	(0.94)	(-1.36)		
1977	-0.018	0.031*	1.010*	0.021	0.003	0.924	0.010
	(-1.95)	(5.13)	(31.90)	(1.84)	(1.40)		
1978	-0.018*	0.044*	0.980*	0.018	0.002	0.945	0.009
	(-2.17)	(10.94)	(37.10)	(1.81)	(0.86)		
1979	0.006	0.026*	1.010*	-0.002	-0.002	0.923	0.012
	(0.54)	(6.91)	(33.12)	(-0.15)	(-1.04)		
1980	-0.068	0.079*	0.660*	0.080	0.006	0.668	0.025
	(-1.28)	(6.62)	(10.89)	(1.33)	(1.06)		
1981	-0.060	0.040*	0.082*	0.080	-0.006	0.908	0.014
	(-1.80)	(7.18)	(20.47)	(1.90)	(-1.78)		
1982	-0.030	0.040*	0.660*	0.050	-0.009	0.828	0.020
	(-0.70)	(6.55)	(11.65)	(1.00)	(-1.83)		
1983	-0.013	0.028*	0.826*	0.020	-0.006	0.930	0.013
	(-0.48)	(5.26)	(21.08)	(0.73)	(-1.78)		

Notes: t-statistics in brackets;

* significant at 5% level, $t_c = 1.960$ (two-tail test);

$\overline{R}^2$ coefficient of determination adjusted for d.f.;

σ = standard error of the estimates;

Number of observations = 102.

From the cross-sectional estimates, direct conclusions on the effects of taxation on the dividend distribution cannot be drawn. Throughout the sample period, θ has not been always significant as are the other two explanatory variables. The coefficient of the tax discrimination variable, θ, is of the expected sign in 82 per cent of the cases. However, out of these, θ is significant in only one case. Similarly, the tax exhaustion variable is of the expected sign in most of the cases, but it is significant in only one year. None, however, is uncorrectly signed and significant. Edwards *et al.* (1985) also found no significance when time effect is taken into account. They computed the tax subsidy on a unit of dividend distribution using aggregate tax rates, and used change in dividend per share as a dependent variable. Their results show a substantial decrease in the significance of this tax variable and in its lagged value when time effect is included as opposed to the high significance and the correct sign of the coefficients of the tax variables when only company effect is considered. A number of possible explanations may be given to the differences in the level of significance when the time effect is taken into account.

When cross-sectional regressions are performed, the most important factor to bear in mind is the timing. Do companies respond directly to a change in the tax variable ? Fane (1975) emphasised the need to distinguish timing from the level effects of changes in the tax discrimination variable. If we suppose that the changes in θ (either in the marginal income tax rate or in the imputation rate) are known beforehand, then firms would probably have the opportunity to switch the timing of their dividends payments. They could postpone them until θ is high or, conversely, bringing them forward into periods when the additional tax on dividends is low. If we ignore these timing effects, the coefficient of the tax discrimination variable could be overestimated. In his empirical work, Fane (1975) found that the neglect of the timing effect caused a serious upward bias (nearly 60%) in the estimate of the level effect of changes in the relative rates of taxation on dividend and retentions. Equation (4.3.3) was re-estimated using lagged θ instead of current θ. The results obtained did not change significantly[12].

The relationship between the constant and the tax discrimination variable obtained from the cross-sectional regressions is the same as that from the pooled data. Indeed, the constant is only positive when θ is of the wrong sign (i.e 1974 and 1979) and it is significant only when the tax on dividends is too. Therefore, the hypothesis that firms may be willing not to pay dividends if the shareholders' personal income tax is above a certain level cannot be be rejected. Without including the tax variable, Theobald (1978) found that the constant is positive and significant in most cases. However, this study used time-series data, therefore, it may not be appropriate for comparison.

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12. When OLS is used, the above results in table (4.1) become :

$$\begin{aligned} NDS_{t,i} = \; & \underset{(-5.44)}{-0.014} \quad \underset{(20.79)}{+0.052 EPS_{t,i}} \quad \underset{(64.66)}{+0.81 NDS_{t-1,i}} \\ & \underset{(-2.65)}{-0.002 TAX_{t,i}} \quad \underset{(6.48)}{+0.0208 \theta_{t-1,i}} \end{aligned}$$

$\bar{R}^2 = 0.874 \quad \sigma = 0.0128.$

When time effect is taken into account the results are also similar to the above.

The wrong sign, although not significant, of the tax discrimination variable appear to occur only in 1974 and 1979 in Table 4.2 and Table 4.3. There are mainly two possible explanations. The first relates to the change in the government in 1979 which has brought about a substantial reduction in the level of personal income tax rate. The standard rate of income tax fell from 33 to 30% while the top rate was reduced from 83 to 60%. Given the assumption that directors are taxed at this higher rate, this substantial reduction is very likely to explain the negative sign of the tax variable.

The second explanation for the negative relationship between the dividend distribution and the tax variable in 1974 may be related to the major change in the corporate tax system in 1973, when the imputation system was introduced. It is likely that there was an incentive to delay the payment of dividends until the imputation rate became effective in 1974. This system, as analysed above, encourages companies to increase their distribution by allowing a certain proportion of tax to be deducted from the total tax of the firm. The payment of dividends could also be reinforced in 1974 by the easing in dividend restraint. Edwards *et al.* (1985) included two variables to capture dividend control, they were both significant and with the expected sign.

The above equation (4.3.3) was estimated using linear regression. It is, however, possible that the fact that the log linear specification was not employed, could distort the results. However, the log specification used by Feldstein and King was partly to correct for the heteroscedasticity which is accounted for here by dividing the variables by the total number of shares. Moreover, this specification is not expected to distort the results, as Fane (1975) found the same results without using logs.

The assumption underlying the computation of the tax discrimination variable could bias the coefficient of this variable. However, the above computation seems to be the only way to discriminate amongst the companies. An alternative definition of θ would be to to exclude the average income tax rate of shareholders, and use King's (1977) definition. Using the pooled data, equation (4.3.3) was re-estimated by including $\hat{\theta}$ rather than θ, both the coefficients and the the level of significance were very similar than the results reported above in table 4.1[13].

The sample time period does not allow to analyse the full effects of the imputation system because company's data was available only from 1972, and because of the lagged value of the dividends, the data was actually taken only from 1973. It would have been important to analyse such effect if it is possible to get the data from early 50's so that the major changes in the corporation tax system could be analysed and results could be compared to the previous empirical studies which have used aggregate data.

The statistical tests do not support always the hypothesis that of the significance of the time effects. There is very little difference between

13. Using the OLS the following equation is obtained :

$$
\begin{array}{llll}
NDS_{t,i} = & -0.043 & +0.048EPS_{t,i} & +0.831NDS_{t-1,i} \\
 & (-3.53) & (19.48) & (66.20) \\
 & -0.002TAX_{t,i} & +0.0305\hat{\theta}_{t,i} & \\
 & (-2.40) & (3.72) &
\end{array}
$$

$\bar{R}^2 = 0.871 \qquad \sigma = 0.0128$

Where $\hat{\theta}$ is defined as $\hat{\theta} = \dfrac{1}{1-s}$ with s as the imputation rate.

the trace matrix obtained under these two assumptions. In table (4.2) the Chow test is computed to test whether all the 5 coefficients can be constrained to be equal against the alternative that they vary through time. The null hypothesis are formulated as follows :

$\beta_c = \beta_p$

Where β_c represent the betas obtained from cross-sectional;

β_p are the betas obtained from pooled cross-sectional time series data. The null hypothesis is accepted in 4 cases, i.e. we can say that there is a substantial difference between the coefficients obtained from the two estimates in 7 cases.

The poor significance of the tax variables when cross-sectional regressions are performed may be due to the mis-specification of the econometric techniques used. Indeed, cross-sectional estimates may not be accurate using the ordinarily least squares because we assume that all companies are homogeneous except from the differences arising from earnings per share, tax discrimination variable, tax exhaustion position and their lagged dividend payments. However, there may be some other inter-firm differences which are not taken into account. For instance, if a firm is established well before the beginning of our sample period, it could have had some kind of reputation in the payment of its dividends, while a newly formed company may still be in the process of setting up its desired level of dividends. Moreover, industry classification could be an important determinant of dividend payment. However, because of the relatively small number of time series observations, these characteristics cannot be taken into account. In cross-sectional regressions, the only way of accounting for these possible differences is by using dummy variables. However, this would lead to a substantial decrease in the degrees of freedom. Therefore, until such adjustments could be made, by selecting all companies from only one industry or increase the time series data, the hypothesis that taxation exerts an influence on company dividend distribution cannot be rejected. However, these results cannot be directly compared to these obtained from interviews and/or questionnaires who found that taxation is not a major factor in the dividend decision of companies (Alam (1985), Cadle and Theobald (1985), Edwards and Mayer (1985)). This is because these studies concentrate on a much smaller time period, while in the study we were concerned with a larger sample period.

6. Conclusion :

In this chapter, the effects of taxation on dividend distribution have been tested. Using the Lintner model of dividends, it was found that the dividend tax discrimination variable and the tax position of the firm appear to exert a strong influence on the company's dividend policy. Using pooled cross-sectional time series data, we find that both tax variables considered here are of the expected sign and highly significant. Therefore, the hypothesis of the absence of relationship between dividend policy and the tax variables can be rejected. However, from the cross-sectional estimates direct conclusions on the impact of taxation on dividend policy cannot be drawn. This is due to the fact that in cross-sectional firms cannot be assumed to be homogeneous as they are not selected from one industry. However, not all the coefficients obtained from the cross-sectional are significantly different from these obtained using the pooled data.

These results are based on a certain number of assumptions about the computation of the tax variable. Given the unavailability of information on the categories of shareholders in each company, their respective holdings and their individual marginal tax rate, the average marginal personal income tax rate is mainly based on the directors' interests in the company and on the national average income tax rate. Ideally, it would be worth computing for each one the marginal personal income tax rate. This is a way for further research.

When the tax variable is calculated, the denominator, i.e., the imputation rate is taken as the statutory rate, rather than the effective rate. From the shareholders' position the statutory imputation rate is important as this constitute a basis for the computation of his/her personal income tax. However, as far as the firm is concerned, the application of the imputation rate depends on its tax position. Given the fact than a number of companies are tax exhausted, it is very likely that not all the companies in the sample are able to recover their advanced corporation tax. Although, in these results an attempt was made to capture this effect using a dummy variable to reflect the tax exhaustion position of the firm, a more accurate estimation of the irrecoverable ACT may still be needed. This is clearly one direction for further research.

It is important, when interpreting these results to bear in mind that the model used is not based on any theory, but rather on Lintner's results of interviews. Thus there may be a number of other factors which are not included in the regressions and which could be very important to a particular country, firm or period of study.

In spite of these reservations, the results point to a some influence of taxation on the dividend distribution. However both the short term and the long term impact are small given the low level of the coefficient. This could explain the stability in the dividend pay-out ratio.

CHAPTER V

TAXES AND INVESTMENT BEHAVIOUR

This chapter investigates the different influences on investment expenditure. In the first section the neoclassical model is presented, followed by some criticisms and extensions. In section 2 the different alternative models of investment are critically analysed, together with the role of liquidity in explaining investment behaviour. Section 3 deals with the more recent investment equation which attempts to explain investment expenditure through the valuation ratio.

1. The Neoclassical Framework :

The present section does not intend to deal in details with vast literature on investment (see Jorgenson (1971), Bridge (1971) and Lund (1976) for a survey). Most previous studies have concentrated on time-series data and at the aggregate, thus not in the spirit of the present analysis. For instance, these econometric studies did not agree on the definition of the production function, or lag structures which are more problems related to economics rather than to management. However, some points relating to the assumptions of these models need some discussions, and thus will be dealt with accordingly.

1.1 The Jorgenson Model :

The neoclassical model was first developed by Jorgenson, in a series of papers in the mid-1960s and early seventies (Jorgenson (1963, 1965, 1967). This theory is then extended by Hall and Jorgenson (1967, 1971). The model is derived from a theoretical work based on the maximisation of profits by a firm, as opposed to previously employed *ad hoc* approaches such as the accelerator or liquidity models. The accelerator model assumes that investment is solely dependent on the level of output and the liquidity models relate investment only to profits. The Jorgenson model combines both these effects as it is based on the recognition that the decision to invest depends on the stream of returns (which in turn are a function of product market conditions, factor costs and tax rates), interest rates, the price of capital goods and output. Furthermore other studies have assumed a fixed capital-output ratio, while Jorgenson introduced into his model a neoclassical production function, thus recognising the possibility of capital-labour substitution.

The neoclassical model of investment assumes that companies operate in a competitive market, seek to maximise profits (defined as the difference between the current revenue and current outlay less the rental value of capital services) over time. They are, however, subject to a set of technological constraints reflected in the production function which describes the proportion of labour and capital necessary to produce a certain level of output, and in the evolvement of capital stock. Under these conditions, the firm will increase its capital expenditure up to the point where the marginal revenue product of the last unit is equal to the cost of using it for one period.

To formalise this relationship, let P_q be the price of output, MPP_k be the marginal level of output attributed to a unit increase in capital and the cost of using the capital for one period by c. Then the following relationship holds any time :

$$P_q * MPP_k = c \tag{5.1.1}$$

In the absence of taxation, the rental price of capital, c, is derived by multiplying the acquisition price of capital P_k by a fraction equal to the rate of interest, i, plus depreciation of assets during the period, δ, minus any capital gains resulting from a change in the assets' price, $\dot{P}_k$:

$$c = P_k (i + \delta - \dot{P}_k) \tag{5.1.2}$$

The rental price of capital measures the minimum rate that an investment must earn to break even. Formulation (5.1.2) can be extended to incorporate tax effects. There are basically two tax variables that could influence the user cost of capital : The corporation tax rate and the capital allowances. The former increases the user cost of capital because it reduces the after tax return on the investment. The latter, on the other hand, has the opposite effect as it reduces the cost of obtaining an equipment (initial and/or investment allowance) or lowers the depreciation charges (depreciation allowances). With the introduction of taxation, equation (5.1.2) for the user cost of capital becomes :

$$c = \frac{P_k (i + \delta - \dot{P}_k)(1 - A)}{(1 - \tau)} \tag{5.1.3}$$

Where A is the present value of allowances;

τ is the effective corporation tax faced by the firm.

Therefore, instead of formulating an empirical investment equation with separate evaluations of the effects of interest rates, changes in prices of capital and a wide variety of tax factors, the computation of the user cost of capital, c, allows all these factors to be combined together into a single variable.

The empirical relationship between the investment expenditure and the tax variables depends critically on the specification of the production function which determines the marginal physical product of capital (MPP_k). It relates to the technological relationship describing the ability of the firm to substitute between capital and labour at different levels of output. If the production technology can be described by a Cobb-Douglas production function, then there is a fixed relationship between labour input and capital input in the process of producing a given level of output. The quantity of output, Q, is obtained from the following relationship :

$$Q = AK^{\alpha}L^{\beta} \tag{5.1.4}$$

The marginal product of capital is given by :

$$\frac{\partial Q}{\partial K} = \alpha\frac{Q}{K}$$

and the optimality condition is achieved where :

$$\frac{c}{P_q} = \alpha\frac{Q}{K}$$

Where α is the elasticity of output with respect to capital. The desired capital stock is thus given by :

$$K^* = \alpha\frac{QP_q}{c} \tag{5.1.5}$$

The desired capital stock is proportional to the value of output deflated by the price of capital services. Therefore, there are two main determinants of the desired capital stock, namely value of output, QP_q, and the relative price of capital services, c.

The capital stock is assumed to evolve over time according to the following process :

$$(K_t - K_{t-1}) + \delta K_t = I_t \tag{5.1.6}$$

which states that gross investment is composed of new capital stock $(K_t - K_{t-1})$, plus replacement investment (δK), where δ is the rate of depreciation.

The present demand for capital by the firm is based on stock rather than flow model. Equation (5.1.6) and (5.1.5) cannot simply be combined to arrive at the investment equation. Any investment programme involves some stages in its development. These processes relate to the initiation of the project, appropriation of funds, finding contractors, issuing of orders before the actual investment takes place. Thus, the investment expenditure may be regarded as an extended process with substantial lags in between these stages, some of which are finished in the current period and some others are carried over from previous periods. The desired capital stock in the above equation (5.1.5) at the end of the period, includes the existing capital stock, the new starts in the period and the backlogs of uncompleted projects. If ω_0 is the proportion of an investment project completed in its first year, then the "starts" (S) and the investment expenditure in period t are related by :

$$I_t = \sum_{i=0}^{t-1} \omega_i S_{t-i} \qquad (5.1.7)$$

Using the lag operator, equation (5.1.7) can be written as :

$$I_t = \omega(L)S_t = (\omega_0 + \omega_1 L + \omega_2 L^2 + \dots\dots + \omega_{n-1} L^{n-1})S_t \qquad (5.1.8)$$

Rearranging this equation, Jorgenson obtained the following investment equation :

$$I_t = \omega(L)[K_t^* - K_{t-1}^*] + \delta K_{t-1} \qquad (5.1.9)$$

The level of new starts is equal to the changes in the desired capital stock from one period to another plus replacement investment which is assumed to be proportional to the beginning of the period existing capital stock.

Since the relative price ratio, $(\frac{P_q}{c})$, is one of the main determinant of the investment behaviour, then any changes in the user cost of capital would result directly in a major shifts in the level of investment undertaken by the firm. In particular the immediate effect of a change in tax policy would be an initial shift in the desired capital stock which will move to its new level, a permanent change in gross investment resulting from replacement of a different level of capital stock and finally in a proportionate change in net and gross investment caused by changes in other determinants of desired capital stock.

From equation (5.1.3) of the user cost of capital it is immediately clear that :

$$\frac{\partial c}{\partial A} < 0$$

and

$$\frac{\partial c}{\partial \tau} > 0$$

An increase in the present value of allowances, A, lowers the cost of capital to the firm and consequently increases the level of the desired capital stock, and as a result the level of investment. Moreover, if desired capital stock increases then once actual stock has increased to its new desired level, the long run increase in investment expenditure will only be that sufficient continually to replace the extra capital stock. Therefore, the long run increase in I_t will be $\delta\partial K_t^*$ (Thomas 1985). Using equation (5.1.5) and (5.1.3) and assuming that there are no capital gains, then :

$$\frac{\partial K_t^*}{\partial c_t} = -\alpha \frac{P_q Q_t}{c_t^{\,2}} \tag{5.1.10}$$

and

$$\frac{\partial c_t}{\partial P_{k_t}} = \frac{(i + \delta)(1 - A)}{(1 - \tau)} \tag{5.1.11}$$

Combining equation (5.1.10) and (5.1.11) we obtain :

$$\frac{\partial K_t^*}{\partial c_t} \frac{\partial c_t}{\partial P_{k_t}} = -\alpha \frac{P_q Q_t}{c_t^{\,2}} \frac{(i - \delta)(1 - A)}{(1 - \tau)} \tag{5.1.12}$$

Using the value of α obtained from the regression and taking the values for P_{q_t}, Q_t, i_t, P_{k_t} and τ_t as an average for the whole period or as a values for the last period, the long run response in the present value of allowances may be estimated. Similarly, the long run elasticity of the desired capital stock to the corporation tax rate τ_t can be obtained by taking an average for the present value of the allowances A. From equation (5.1.12) the elasticity of K_t^* with respect to P_{q_t} is -1. This is because of the assumption that the production function is of the Cobb-Douglas form. This make the elasticity of desired capital stock to both output and to the relative price ratio to be unity. The long run elasticities of the investment expenditure with respect to its determinants, remains however, a basic limitation of the model.

Hall and Jorgenson (1967, 1971) have computed the effects of changes in taxation on investment by calculating the rental price of capital, c, on the assumption that the change in policy did not take place. The changes in the desired capital stock and investment for the resulting rental price of capital are calculated using the parameters estimated from the investment equation. Then the user cost of capital is re-calculated on the assumption that particular policy has taken place. The resulting changes in the desired capital stock and investment from the fitted investment functions are calculated. The difference between the two policies is thus determined. Applying this model to the US economy, they concluded that :

"Tax policy has been highly effective in changing the level and timing of investment expenditures... The adoption of accelerated methods of depreciation and the reduction in depreciation lifetimes for tax purposes increased investment expenditure substantially. They also resulted in a shift in the composition of investment away from equipment towards structures. Limited to equipment the investment tax credit has been a potent stimulus to the level of investment." Hall and Jorgenson (1971) p. 11.

1.2 Criticisms of the Jorgenson Model :

The hypothesis that tax allowances stimulate investment is not, however, overwhelmingly supported. Using the aggregate data of Sweeden during the 1963-80 period, Dergstrom and Sodersten (1984) concluded that the tax allowances aimed at lowering capital costs and stimulating investment may have resulted in an increase in profits on investment that would have been undertaken regardless of the tax incentives. Eisner (1971) argued for the possibility that a decrease in the corporate tax rate would have a negative impact on corporate investment. Furthermore, Hall and Jorgenson (1969) assumed that the before tax rate of return is left unchanged when they simulated their results. If corporate tax increases, then, because of the differential treatment of returns to debt holders and shareholders, the before tax yield on real investment should be higher to allow payment of the same after tax return to shareholders and bondholders.

The above conclusions on the strong effects of taxation on investment expenditure may be due to the basic assumptions underlining the model used. These relate to the specific treatment of the tax variables in the model, the elasticity of substitution between capital and labour, and also to the treatment of inflation. These are dealt with separately in the following.

1.2.1 Specification of the user cost of capital : The major deficiency with the Jorgenson formulation is that it does not allow for tax-exhausted firms to be included in the estimated sample. The problem arises because of the asymmetrical in the tax system whereby, under the above formulation of the user cost of capital, the effects of capital allowances and of the effective corporation tax operate only for those companies that do actually end up paying the mainstream corporation tax. If the effective corporation tax of one company is negative, meaning that it does not recover fully its allowances, then the denominator of the user cost of capital (equation 5.1.3) becomes positive and greater than unity. This would mis-specify the user cost of capital. Similarly, if the effective corporation tax is negative, the present value of allowances would be negative and the user cost of capital will be higher. There are no, a priori, ways of making adjustment for the user cost of capital to account for such effects. If all tax exhausted companies are assumed to have zero tax, then the optimal level of capital stock would be incorrect and companies that are highly tax exhausted are assumed to behave in the same manner as those that are just tax exhausted. It may be possible that companies that are just tax exhausted may refrain from undertaking only marginal projects, while, on the other hand, companies that are highly tax exhausted may even not be able to undertake necessary projects. To treat all the firms in the same way, the optimal level of capital stock may be calculated without incorporating any tax variable in the user cost of capital. However, here again, the desired capital stock will be incorrect as the after tax user cost of capital is significantly different from the after tax value.

Another problem with the original Jorgenson model is that firms are assumed to have static expectations with respect to tax policy. They are considered to plan their investment projects on the basis that the present tax rules regarding tax rates and capital allowances will remain unchanged. Such expectations may lead to anticipatory attitudes, thus making investment substantially different from the long run desired capital stock. The neoclassical model in these conditions may fail to predict fully the tax impact. Similar problems arise in the treatment of the cost of capital which is computed as the average cost of finance, while in investment decisions, the marginal cost of capital is more relevant. This assumption may be relaxed when the CAPM is used to compute the cost of equity.

1.2.2 Production function : The Cobb-Douglas production function assumes that the lagged response pattern of investment with respect to output and relative price changes is constrained to be the same. It is possible, though, that firms may respond more quickly to changes in the level of output that to movements in factor prices (Bischoff 1971). If this is the case, the coefficient of the desired capital stock will be biased, and therefore, the sensitivity of the firm's desired capital stock to changes in taxation should be estimated rather than imposed.

An alternative representation of the production function which allows for the elasticity of substitution to be estimated is a constant elasticity of substitution (CES). If the production function has a constant returns to scale and a constant elasticity of substitution[1] between capital and labour and if capital is completely malleable, then the optimal capital stock (equation 5.1.5) becomes :

$$K^* = \alpha^{\sigma} \frac{P_q}{c}^{\sigma} Q \qquad (5.1.13)$$

Where σ represents the elasticity of desired capital stock with respect to relative prices.

When the CES specification is employed, the Jorgenson model becomes nonlinear and thus has to be estimated using a logarithmic regression equations. Equation (5.1.9) becomes :

$$\ln I_t = w(L)\Delta \ln K_t^* + \ln \delta K_{t-1} \qquad (5.1.14)$$

There is no however a single estimation of σ. Eisner and Nadiri (1968) and Coen (1969, 1971) obtained estimates of σ closer to zero than to one, thus reducing the neoclassical investment equation to the simple accelerator model where investment is only determined by the

1. The marginal productivity equation for capital under CES production function leads the optimal desired capital to be :
$$K^* = \alpha(\frac{P_q}{c})^{\sigma} Q^{\sigma + (1-\sigma)/v} = \alpha(\frac{P_q}{c})^{E_r} Q^{E_Q}$$
Where E_r, the elasticity of desired capital with respect to relative prices may be different from $E_Q = \sigma + (1-\sigma)/v$, the elasticity of capital with respect to output. It is only when v, the return to scale parameter is equal to 1 and where there are constant returns to scale that this elasticity is equal to 1.

level of output. Using aggregate UK data, Boatwright and Eaton (1972) estimated σ to lie between 0.4 and 0.7, Jenkinson (1981) found a preferred value of 0.25, while Savage (1977), Bean (1981) and Bosworth (1984) adopted a value of half on practical grounds.

The advantage of the logarithmic approach over the linear specification is that it allows all the elasticities of the desired capital stock in respect of the components of the user cost of capital to be estimated. Feldstein and Flemming (1971) found some significant elasticities of the components of the user cost of capital. Assuming a zero capital gains, equation of the user cost of capital (5.1.3) becomes :

$$\left(\frac{c}{P_q}\right)^{+} = \left(\frac{P_k}{P_q}\right)^{\beta_1}(r+\delta)^{\beta_2}(1-\tau)^{-\beta_3}(1-A)^{\beta_4}\theta^{\beta_5} \qquad (5.1.15)$$

Where θ, as defined in chapter 4, is a differential tax parameter reflecting the extent to which dividends are taxed more heavily than retained earnings[2] and it measures the effects of internally generated funds. If β_5 is negative then the firm treats retained earnings as a less expensive source of finance than borrowings.

When constraining the user cost elasticities to be equal, the overall elasticities of around 0.2 and 0.5 were obtained. On the other hand, when this constraint is relaxed, the elasticity of the desired capital stock with respect to the allowance variable is -1.4 but it is small to

2. During the sample period 1954:2 to 1967:4 the imputation rate system was not in operation. Corporations were taxed at two separate rates depending on whether they distribute profits, τ_d or retain them, τ_u. Therefore : $\theta = \dfrac{1-\tau_y}{1+\tau_d-\tau_y-\tau_u}$ Where τ_y is the standard rate of income tax.

the differential tax parameter, and not significant with a wrong sign to the other components of the user cost of capital. These results has led Feldstein and Flemming to conclude that :

"First, higher allowances increased the flow of internally available funds which may have had an independent positive effect on investment. Second, the frequent changes of the allowance rate may have induced firms to try to concentrate investment expenditures on periods on which rates were high by accelerating investment when allowance rates were raised and postponing when they were expected to rise in the future. The estimates of approximately -1.4 may therefore reflect the timing of government policy: more frequent changes, and particularly more decreases might have resulted in even greater responsiveness." Feldstein and Flemming (1971) p. 427.

Feldstein and Flemming argued that for these reasons, the results that the coefficients are greater than 1 do not necessarily mean that the Cobb-Douglas production function is inappropriate. Furthermore, the CES production function has been fraught with theoretical difficulties (see Eisner and Nadiri (1968), Coen (1969, 1971), Bischoff (1969) and Jorgenson and Stevenson (1969) for the debate). More recently, Feldstein (1982) compared the different specifications of investment behaviour, using the US investment in equipment during the period 1954-1977. He found that, on the basis of goodness of fit, the Jorgenson specification performed the best. Jenkinson (1981) also found the linear specification to be preferred to the logarithmic equation, and when similar specification to Feldstein and Flemming (1971) was estimated, the results were somewhat perverse with the interest rate significantly uncorrectly signed and the output variable is also uncorrectly signed.

Savage (1977), on the other hand, assumed that the desired capital stock may be approximated by an additive, rather than a multiplicative, combination of the relative components. The desired capital stock in equation (5.1.5) becomes:

$$K_t^* = \alpha_1 \frac{P_q}{P_k} + \alpha_2 \frac{(1-A)}{(1-\tau)} + \alpha_3 r + \alpha_4 Q \tag{5.1.16}$$

In this specification, the rate of depreciation, δ, is ignored because it is assumed to be a constant in the computation of the user cost of capital. Tax impact is combined in the term $(1\text{-A})/(1\text{-}\tau)$, the ratio of gross to net yield on a unit of capital expenditure. It is interpreted as a measure of the overall effect of the tax incentives and the tax rate on the rate of return on capital. This specification, referred to as the 'generalised' neoclassical model of investment, results in a change of equation (5.1.9) into :

$$\begin{aligned} I_t = & \sum_i^n \omega(i)_1 \Delta \left(\frac{P_q}{P_k}\right)_{t-i} + \sum_i^n \omega(i)_2 \Delta \frac{(1-A)}{(1-\tau)}_{t-i} \\ & + \sum_i^n \omega(i)_3 \Delta r_{t-i} + \sum_i^n \omega(i)_4 \Delta Q_{t-i} + \delta K_{t-1} \end{aligned} \tag{5.1.17}$$

The estimation of equation (5.1.17) did not provide some consistent results on the impact of taxation on investment behaviour. For the sample periods 1959:1 to 1973:4 and 1959:1 to 1976:4, Savage found that only the coefficient on the change in output and the price ratio are of the expected sign and significant during both these periods for the UK aggregate data. The coefficient of the tax variable is of the correct sign but insignificant in the first period. It is, however, of the wrong sign and significant in the second period. Similar results were found by Levis and Morgan (1985) who found that for the whole period (1968:4 to 1984:4) the coefficient of the tax variable is negative but insignificant, but for the period 1967:4 to 1979:2 this coefficient is of the wrong sign and significant.

1.2.3 Inflation effects : The inflation factor is dealt with directly by the neoclassical model because all the variables are deflated into constant prices. it is also indirectly incorporated in the user cost of capital through the capital gain term in equation (5.1.3), which, when uncertainty is properly accounted for, is treated as an expectation of the inflation rate. However, because of the absence of efficient market for second hand equipment the firm may not be able to take full replacement cost value for the sale of its equipment. Nickell (1978) argued, as a consequence, that the capital gain term in equation (5.1.3) should enter with a coefficient of less than unity. This would avoid the computation of a negative user cost of capital in the mid-70's. However, using a grid search, Jenkinson (1981) found that the best equation was given when the weight for the inflation rate is zero, i.e. computing the user cost of capital without the capital gain term.

Inflation may also enter in the user cost of capital through the cost of finance and the depreciation rate used. Hendershott and Hu (1981) computed the expected real after tax financing rate by deducting expected inflation rate from the cost of debt capital. The expected inflation rate is assumed to be a distributed lag on past inflation rates with different weights for each of the 7 quarters. The basic inflation rate is the adjusted deflator for non-food business products. This inflation rate is also used to compute the average annual rate of tax depreciation.

As pointed out in chapter 2, the computation of the economic depreciation is very complicated (see Green Paper on Corporation Tax

(1982) for a summary). King and Fullerton (1984) on the other hand have attempted to approximate the economic depreciation from a straight line depreciation method, which is used by many companies[3] and by the Central Statistical Office (CSO) in the National Accounts. The economic depreciation is roughly obtained by dividing 2 over the life of the assets, while the straight line depreciation rate is computed by dividing 1 by the asset life.

2. Alternative Models of Investment :

Similarly to the previous model, most of the following alternative studies have taken the view that profitability is a crucial determinant of investment behaviour. A large part of these studies have used cross-sectional and time-series data at company level to test empirically the investment expenditure. They are thus worth analysing as they are in the spirit of the present study.

2.1 Liquidity Theory :

An early study by Meyer and Kuh (1957) used an electic Accelerator Residual Funds model to analyse the role of demand and profit in explaining the investment behaviour of a sample of 15 industries over the period 1946-1950. They found that while demand was the major determinant of investment during the boom years 1946-1948, in the remaining years cash flow defined in terms of profit and depreciation appear to be the most significant. However, in the extension of this

3. The Institute of Chartered Accountants (ICA) (1982) has reported that the straight line depreciation method is used widely by the UK companies for all or most of their assets.

model from 1951 to 1954, Meyer and Glauber (1964) found that the cash flow variable performed poorly mainly during the recession of 1954. Similar model was tried more recently by Meeks (1981) using data on 18 UK individual two-digit industries for the period 1967 to 1971. He found that only depreciation variable was in most cases significantly and positively associated with investment spending. The liquidity stock[4] was only significant in 6% of the cases.

Kuh (1963) also found little significance for the internal fund flow or profit model comparing to the accelerator sales model. He performed both cross sectional and time series regressions on 60 companies which produce capital goods during the period 1935 to 1955. He used three different equations to compare profits and capacity utilisation theories of investment behaviour. The flow of funds (sum of retained earnings *plus* depreciation) is only significant in the cross-sectional regressions and when it is lagged or deflated by the capital stock.

Grunfeld (1960) found little significance for the realised profit in explaining investment behaviour when profits were incorporated into a flexible accelerator model, using annual data, 1935-1954, of 8 individual US corporations. Profits were found to be highly correlated with other determinants of investment. He argued that expectations of future profits cannot be based solely on realised profits since both general business optimism and anticipated changes in the supply and demand conditions are relevant. He then specified

4. Liquidity stock is defined as cash and bank balances *plus* tax reserve certificates and marketable securities *minus* bank overdrafts and loans, dividends interest and tax liabilities.

his investment theory in terms of expected profits, but since the latter are not observable directly, he assumed that the market value at the end of the year to be a measurable substitute. His theory is referred to as the expected profits model of investment.

Dhrymes and Kurz (1967) used a different method to test the relationship between investment and profitability of a sample of 181 manufacturing, mining and retail trade firms for the period 1951 to 1960. They criticised previous studies for failing to account for the interaction of financial and investment decisions. They developed a simultaneous model of dividends investment and external finance. Using cross sectional data and a Full Information Maximum Likelihood, they found that the coefficient of the change in the sales variable exhibits much more stability than that of the lagged rate of profit. However, the influence of the profit on investment was not restricted to its coefficient because of the fact that profits were a significant determinant of dividends, and dividends were found to compete with investment funds.

Similar investment equations have been used to test for the relationship between the financial variables and the investment expenditure. The independence of the investment and dividend decisions have been tested empirically by Fama (1974) with a sample of 298 American companies for the period 1946-1968, by Morgan and Saint-Pierre (1978) with a sample of 64 Canadian firms for the period 1960-1974 and by McDonald, Jacquillat and Nussenbaum (1975) for a sample of 75 French companies during the period 1962-1968. On the other hand, similarly to Dhrymes and Kurz (1967), McCabe (1979) and Peterson and Benesh (1983) have rejected the independence hypothesis of dividends and investment in a two and three-stage least squares cross-sectional studies. These studies found dividends to be negatively correlated to the investment expenditure because the outlays for investment and dividends are viewed as competitive. Dhrymes and Kurz find that the coefficient of dividends in the investment equation is both negative and significant in 8 of the 10 years analysed while McCabe found a proportion of 8 out of 8 years examined.

Peterson and Benesh (1983) used a slightly different specification for a sample of 538 firms during the period 1975 through 1979. They fitted the investment, dividend and new debts equations cross-sectionally using simultaneous equations estimating techniques of two- and three-stage least squares. They also employed the seemingly unrelated regressions (SUR) estimation technique. They found that the coefficient of the dividend variable in the investment equation is negative in each of the 5 years and significant in 4 years.

Jorgenson and Siebert (1968) used annual data on 15 US companies for the period 1949-1963 to compare the above investment theories. The distributed lag function ω (L) is limited to current and up to two lagged values of both the change in desired capital stock and net investment, because annual as opposed to quarterly data was used. Their best model is found to be the neoclassical with capital gains, as it shows the minimum residual variance subject to the weights of ω_0 to be positive. The general form of the equation used is :

$$I_t = \gamma_0[K_t^* - K_{t-1}^*] + \gamma_1[K_{t-1}^* - K_{t-2}^*] + \omega_1[I_{t-1} - \delta K_{t-2}] + \delta K_{t-1}$$

The difference in the models compared is in the definition of the desired capital stock K^*. The following table summarises the overall performance of the different theories and gives the number of times each theory obtains rank 1 (smallest residual variance) to rank 6 (largest residual variance) :

TABLE 5.1. COMPARISON OF INVESTMENT MODELS

THE RELATIVE PERFORMANCE OF INVESTMENT THEORIES							
THEORIES	RANKS						
	1	2	3	4	5	6	OVERALL
NEOCLASSICAL I (1)	5	7	2	1	0	0	1
NEOCLASSICAL II (2)	5	4	1	1	4	0	2
EXPECTED PROFIT (3)	2	1	6	4	2	0	3
CRUDE ACCELERATOR (4)	2	2	2	5	1	3	4
LIQUIDITY (5)	1	1	2	2	5	4	5
NAIVE (6)	0	0	2	1	5	7	6

Source : Compiled from Table 3 Jorgenson and Siebert (1968)

Notes : (1) $K_t^* = \alpha \dfrac{P_{q_t} Q_t}{c_t}$

Where $c_t = \dfrac{P_{k_t}[(1-v_t\,\omega_t\,)\delta + i - (P_{k_t} - P_{k_{t-1}})/P_{k_t}]}{(1-\tau)}$

v_t and ω_t are tax rate on net income and tax allowance for debt finance respectively.

In equation (2) the formula for the desired capital stock is the same as (1) but the user cost of capital is defined without capital gains.

(3) $K_t^* = \dfrac{MVS + BVD}{GNP}$

MVS, BVD and GNP are respectively market value of shares, book value of debts and the gross national product.

(4) $K_t^* = \Delta Q_t$ where Q is the level of output.

(5) $K_t^* = \pi_t$ where π is the sum of retained profit and depreciation deflated by P_k.

(6) $I_t = \beta_0 + \beta_1 I_{t-1} + \beta_2 I_{t-2} + \beta_3 I_{t-3}$

From the above table, the neoclassical model with capital gains appear to have the smallest residual variance for 5 of the 15 companies in the sample and the second smallest for another 7 firms, therefore, already 80% of the companies fit the neoclassical model as opposed to the naive model where this proportion has the largest and just below the largest residual variance. The last column gives the average performance of the theories. The worst model appear to be the naive specification and the liquidity model. This led Jorgenson and Siebert to come to the same conclusion as Kuh (1963) that financial constraints play a minor role in explaining investment behaviour of individual firms. Thus the evidence presented in this study is overwhelmingly in favour of the neoclassical model when time-series data is used.

However, the sample of firm is relatively small and cross-sectional estimates were not performed. Elliot (1973) re-estimated Jorgenson's and Siebert analysis for a much larger sample of 184 firms. When time-series data is used, there was little difference between the neoclassical, accelerator and the liquidity models. On the other hand, when cross-sectional data was employed, liquidity model was found to perform the best followed by the accelerator, expected profit and the neoclassical.

2.2 Effects of Cash Flow :

There are a number of arguments that have been advanced to explain the relevance of the availability of internal funds in explaining the investment behaviour. Chapter 3 of this research has shown how risk and the particular tax position of the firm may constrain the firm from borrowing. Moreover, the high transaction costs incurred in an issue together with the preference of debts over equity because of tax deductions of interest payments, make equity issues less attractive to the firm[5].

Baumol *et al.* (1970) have presented empirical evidence to show the importance of retained earnings in the financing of low yields projects. If a firm has large amount of cash flow available it would relax any constraint imposed by external finance upon its investment programme. However, there are a number of considerations to take into account when dealing with the availability of internal funds.

There is first of all the problem of the specification of the investment equation. In the above models, liquidity variables are assumed to be linearly related to the investment expenditure, and their changes are considered to influence the long-run capital stock. However, Jorgenson (1971) in surveying a large number of US econometric studies concluded that :

"Where internal finance variables appear as significant determinants of desired capital, they represent the level of output. Where both output and cash flow are included as possible determinants, only one is a significant determinant. The preponderance of evidence clearly favours output over cash

5. Other factors that can make new share issue less attractive include the costs of providing information on past and expected profit performance to make the issue acceptable to the existing and new shareholders, risks of being taken over because of such disclosure, possible losses in capital gains to the existing shareholders if the price falls and the possibility that the amount the firm wants to raise may not be accepted by the market.

flow." *p. 1133.*

Furthermore, Nickell (1978) argued that the availability of cash flow can only be related to the desired expansion which, in turn is a function of the demand. When a variable of cash flow is included in the accelerator type model, the results suffer from the problem of multicollinearity amongst the explanatory variables.

Alternatively, the liquidity variable is considered to influence the speed of adjustment rather than the long run level of stock. Coen (1971) modified the neoclassical model by making the speed of adjustment a function of cash flow. Firms are likely to accelerate their investment expenditure when the profits for example, are high. In this theory, the effects of a reduction in the profits might be to delay but not to cut investment.

Another way of considering the effects of cash flow is through the user cost of capital in the neoclassical model. Feldstein and Flemming (1971) allowed for a separate term in the user cost of capital to reflect the availability of internal funds, but they found that this reduced the relative price effects to insignificance. However, since the user cost of capital already includes the cost of finance, we would expect liquidity effects to be incorporated in this variable, and investment is expected to be negatively correlated to the cost of finance. Since the cost of internal funds are relatively lower than that of debts, the availability of internal funds will thus encourage investment.

However, previous studies on the relationship between investment behaviour and the cost of capital are rather unconclusive. Using aggregate data, most studies, at the exception of Hines and Cataphores (1970) and Bean (1981), did not find that the cost of capital is an important determinant of investment. Savage (1978) concluded from the survey of econometrics studies that

"Hardly any British research has been able to show that interest rates are an important influence on aggregate business investment." *p. 78.*

Furthermore, the survey of Wallis *et al.* (1984) have reported that most econometric models in the UK contain only limited representation of factor prices effects, and more empirical support is given to liquidity and cash flow. Since these models deal with the aggregate data, this irrelevance of the cost of capital may be explained by the absence of a suitable aggregate measure for the different costs of finance. Even at company level, it is only recently that empirical evidence is found on the use of the net present value method in the selection of investment. In the 1960s the discounting cash flow method appeared to be practiced by only a minority of companies (William and Scott (1965) and Nield (1961)). But more recently, Carsberg and Hope (1976) and Pike (1983) found an increasing use of discounting techniques among large companies, but most firms were found to combine the discounting cash flow with other alternative evaluation methods and the sophisticated methods were found to be used in only large companies.

The computation of the cost of capital also presents a number of problems. It requires the calculation of the marginal costs of new finance as opposed to the average cost of existing funds. Flemming *et al.* (1976) have taken the view that the post tax cost of finance is equivalent to the implicit rate at which companies expected post-tax future earnings are discounted by the market. They proxied unobservable expected real future earnings by current earnings over market value of shares. King and Fullerton (1984) on the other hand have measured the cost of finance as the weighted average marginal cost of all different sources of finance, each source with its relative tax. The basic assumption in their model is that shareholder can earn the same rate of return whether he invests in the company or invest at the market interest rate. Thus the effects of risks are not incorporated, and it is only through taxation that an investor would choose to invest in the company or in other alternative investments[6].

More recently, Poterba and Summers (1983, 1985) have derived from an optimisation model a formula for the cost of capital. Earnings are split into dividends and capital gains. Dividends are assumed to communicate information, and the cost of equity is a function of the pay-out ratio. This method allows both capital gains tax and tax price on dividends to be incorporated into one factor.

3. Q Model of Investment :

The main alternative model to that developed by Jorgenson is the

6. The cost of equity is thus computed as : $\frac{1-m}{1-s}\rho = (1-m)r$ Thus $\rho = \frac{r}{1-s}$
Where ρ, r, m and s are respectively the cost of new equity, the market interest rate, the marginal income tax rate of shareholder and the imputation rate.
The cost of retained earnings is similarly defined as : $(1-z)RE = (1-m)r$
Thus $RE = \frac{(1-m)}{(1-z)}r$
Where RE and z are the cost of retained finance and the effective capital gains tax respectively.

Tobin "q" theory of investment (Tobin 1969). Similarly to the neoclassical theory, this model's basic approach assumes that the objective of the firm is to maximise the present net worth of the outstanding shares. An investment is undertaken only if it increases the market value of the firm. The market is expected to assess the relative values of the expected returns and expected risks associated with the new project. Tobin defined a variable "q" equal to the ratio of the market value of the firm relative to the replacement cost of its assets as the key determinant of the investment expenditure. This ratio is an indicator of market expectations of future profitability of existing capital stock. If it is greater than its equilibrium value (usually taken as unity), the valuation ratio should stimulate investment activity because the profit stream that will be generated by the new capital is going to be greater than the cost of the extra finance needed to acquire it.

There are, however, a number of different ways of computing the market value of the firm and the replacement cost of capital stock. Furthermore, when taxes are taken into account the equilibrium value of "q" need not necessarily be unity as it may depend on which method of finance used to finance the marginal project and also on the assumption as to the role of dividends. These specifications have led previous studies to find a variety of values of "q" using the same data. Moreover, in spite of its microeconomic origins, the valuation ratio has mainly been applied to test the investment behaviour at the aggregate[7]. The present section attempts to review previous studies that have used this ratio to analyse investment behaviour. Since most of these studies have used aggregate rather than company's data, the concentration is more on the theory than on empirical results.

3.1 Theoretical framework :

The Tobin 'q'[7] theory of investment leads, under some conditions, to the same results as the neoclassical model (Abel (1979), Hall (1977), Ciccolo and Fromm (1979) and Yoshikowa (1980)). The emphasis here is,however, more on the market value of the firm. This model also deals directly with the financial policy of the firm as the equilibrium value of q is derived from the level of dividend distribution, debt equity ratio in addition to the tax factors.

The basic assumption of this model is that firms seek to maximise their market value. This is equivalent to maximising the present value of future after tax net receipts (the assumption of the Jorgenson model) if personal taxes are not taken into account. The technology of the firm is defined in the form of twice differentiable production function with constant returns to scale. The firm is assumed to be a price taker in a competitive market, and to be faced with adjustment costs when it undertakes its investment.

In order to derive this ratio with tax effects, we need, first, to formulate the optimisation problem faced by the firm. The following

7. In addition to investment equations, this ratio has been used as an indicator of the special tax provisions which could be gained if the firm ceases operations (Edwards and Keen 1985), as a measure of monopoly rent (Lidenberg and Ross 1981), as a basis for the decisions on mergers and acquisitions (Chappell Jr. and Cheng (1984) and Holly and Longbottom (1985)) and also as a basis for analysis of the stock return regularity (Solt and Statman 1985).

notations are specified :

V_t = market value of the firm's equity;

$\dot{V}_t$ = one period change in the market value of the firm;

D_t = dividends payments;

I_t = Gross investment expenditure;

p_t = Price of new capital goods;

V_t^n = Value of new share issues;

r_t = risk-adjusted nominal discount rate;

i_t = nominal interest rate on corporate debts;

A_t = present value of investment incentives per unit of new investment;

B_t = present value of writing down allowances on past investment;

b_t = debt-capital ratio;

The income tax variables are (as defined in chapter 4) :

m, z and c the marginal personal income tax rate of shareholders, capital gains tax rate and imputation rate respectively, and

$\theta = \dfrac{(1-m)}{(1-c)}$ = dividend tax discrimination variable.

In order to derive the market value of the firm the return to shareholders are compared under the alternative investment opportunities. To be indifferent between buying shares in one company and holding other assets which yield the market rate of return, the return from both these opportunities should be equal. In a mathematical form, this relationship may be represented as :

$$r_t = \frac{\dfrac{\theta}{(1-z)}D_t}{V_t} + \frac{(1-z)(\dot{V}_t + V_t^n)}{V_t} \qquad (5.3.1)$$

The first term of equation (5.3.1) is the after tax dividend yield and the second term is the after tax capital gains. Rearranging equation (5.3.1) the market value of the firm at time t is :

$$V_t = (1 + \frac{r}{1-z})^{-1} (\frac{\theta}{1-z} D_t - V_t^n + V_{t+1}) \qquad (5.3.2)$$

That is, the market value of the firm at time t is equal to the present value of the sum of dividends and capital gains after tax, discounted by the after tax market return. Equation (5.3.2) can be solved forward subject to the transversality condition which prevents the market value of the firm to be infinity in finite time, i.e

$$\lim_{t \to \infty} \prod_{i=1}^{t} (1 + \frac{r}{1-z})^{-i} V_t = 0 \qquad (5.3.3)$$

to yield the market value of the firm at time 0 as :

$$V_0 = \sum_{i=0}^{\infty} \prod_{i=1}^{t} (1 + \frac{r}{1-z})^{-i} (\frac{\theta}{1-z} D_t - V_t^n) \qquad (5.3.4)$$

This equation simply states that the market value of the firm can be computed as the present value of the after-tax expected dividends *minus* the present value of new share issues which the shareholders will have to acquire in order to keep his holding a constant proportion in the firm's dividends and profits. The firm's objective function is to maximise equation (5.3.4) at any point in time subject to a number of constraints.

The 1948 Companies Act restrict share repurchases and firms cannot pay negative dividends, i.e.,

$$V_t^n \geqslant 0 \qquad (5.3.5)$$

$$D_t \geqslant 0 \qquad (5.3.6)$$

The flow of funds statement requires that sources are equal to uses of funds. This is formulated as :

$$(1-\tau)(F(K_t, N_t)-\Psi(I_t, K_t, \xi_t)p_t - p_t i_t b_t K_t) + V_t^n + \tau B_t = D_t + (1-A-b)p_t I_t \tag{5.3.7}$$

The dividend payment is, thus, equal to :

$$D_t = (1-\tau)(F(K_t, N_t)-\Psi(I_t, K_t, \xi_t)p_t - p_t i_t b_t K_t) + V_t^n - (1-A-b)p_t I_t + \tau B_t \tag{5.3.8}$$

where $F(K_t, N_t)$ is the production function, net of wage costs, with N as the labour input, and $\Psi(I_t, K_t, \xi_t)$ is the adjustment cost function, assumed to be convex increasing with the amount of investment expenditure but decreasing with the capital stock as large firms may undertake projects at lower cost. ξ_t is a random error term in the adjustment cost function.

The capital stock accounting identity is represented by :

$$K_t = I_t + (1-\delta)K_{t-1} \tag{5.3.9}$$

where δ is the depreciation rate on capital goods. It is assumed that no adjustment costs occur when only replacement investment is undertaken.

To maximize equation (5.3.4) subject to the constraints defined in equations (5.3.5), (5.3.6), (5.3.8) and (5.3.9), we construct a Hamiltorian function with shadow values for capital goods, λ_t^1, marginal values for being able to purchase own shares, λ_t^2, and pay negative dividends, λ_t^3, i.e.,

$$H_t = \left(\frac{\theta}{1-z}D_t - V_t^n\right) - \lambda_t^1(K_t - I_t - (1-\delta)K_{t-1}) - \lambda_t^2 V_t^n - \lambda_t^3 D_t \tag{5.3.10}$$

Substituting equation (5.3.7) of cash flow constraint into equation (5.3.10) we obtain :

$$H_t = \left(\frac{\theta}{1-z} - \lambda_t^3\right)\Big[(1-\tau)(F(K_t, N_t)-\Psi(I_t, K_t, \xi_t)p_t - p_t i_t bK_t) - (1-A-b)p_t I_t + \tau B_t - (1+\lambda_t^2)V_t^n - \lambda_t^1(K_t - I_t - (1-\delta)K_{t-1}) \tag{5.3.11}$$

The first order condition for investment at time t may be derived from equation (5.3.11) as :

$$-\left(\frac{\theta}{1-z}-\lambda_t^3\right)\left[(1-\tau)\Psi(I_t, K_t, \xi_t)+1-A_t-b_t\right]p_t+\lambda_t^1=0 \tag{5.3.12}$$

λ_t^1 determines the marginal increase in the firm's value which would results from adding one unit of capital to the firm. Equation (5.3.12), thus, states that, an optimising firm will invest until the marginal cost of the new investment equals the marginal benefit from that investment.

According to Tobin 'q' theory, the investment decision of the firm is function of the ratio of the marginal equity value of capital, λ_t^1 over the price of capital, p_t. In order to make this theory testable, a measure of the shadow price of capital λ_t^1 is required. While in theory marginal market value is the determinant of investment, in practice, only average values are observable. Hayashi (1982) argued that the marginal value of an asset is equal to its average value only if there is homogeneity in the production function and homogeneity in the capital adjustment cost function. Poterba and Summers (1983) noted that, since the new investment activity is independent of the present value of writing down allowances on past investment, (B_t), then the difference between the average market value of the firm and these outstanding writing down allowances will be homogeneous in the initial capital stock. Moreover, internal adjustment cost to yield a linear investment equation were introduced by Summers (1981). From equation (5.3.12) the investment function may be deducted as a function of the adjustment costs as :

$$\Psi(I_t, K_t, \xi_t) = Q_t = \frac{\left[\frac{V_t - B_t}{(\theta/(1-z) - \lambda_t^3) p_t K_{t-1}} - 1 + A_t + b_t\right]}{(1-\tau)} \quad (5.3.13)$$

It is assumed that the firm would never issue new shares and pay dividends in the same time to reduce its overall tax bill. Thus, in case where the firm issues new share to finance its marginal project, then the above shadow cost of new issue, λ_t^2, is equal to zero, and $\lambda_t^3 = (\theta/1-z) - 1$[8]. Therefore, the marginal value of "Q" is :

$$Q_{N,t} = \frac{\left[\frac{V_t - B_t}{p_t K_{t-1}} - 1 + A_t + b_t\right]}{(1-\tau)} \quad (5.3.14)$$

If, on the other hand, the marginal source of finance comes from retained earnings, then the shadow price of new issue, λ_t^2, is zero. In this case, marginal Q would become :

$$Q_{R,t} = \frac{\left[\frac{1-z}{\theta}\right]\left[\frac{V_t - B_t}{p_t K_{t-1}} - 1 + A_t + b_t\right]}{(1-\tau)} \quad (5.3.15)$$

The above equations (5.3.14) for new issue and (5.3.15) for retained earnings, have been tested using aggregate industrial and commercial companies data, to find strong support for both personal and corporate taxes in influencing the level of investment expenditure. The traditional view of dividend policy is supported by the results. As a consequence, dividend taxes discourage corporate investment.

A number of other specification of Tobin 'q' theory have been used to

8. From equation (5.3.11) we deduct the first order conditions for new issue and dividend payments as :
$$\left(\frac{\theta}{1-z} - 1 - \lambda_t^3 - \lambda_t^2\right) V_t^n = 0$$
and $D_t \lambda_t^3 = 0$ respectively.

explain the investment behaviour. Jenkinson (1981) defined tax adjusted Q as the ratio of the total market value of industrial and commercial companies in the U.K. over the sum of capital stock and stock and work in progress adjusted for present value of capital allowances and stock relief. Oulton (1981) derived the equilibrium value of Q as the ratio of the capitalised values of dividends, interest payments and 'profit due abroad' adjusted for income from overseas and from financial assets. The denominator of Q is computed as the sum of capital stock and stock and work in progress at replacement cost, adjusted for the present value of capital allowances and stock relief. The present value of depreciation allowances on old capital stock is computed assuming a steady state economy, where investment grows at constant rate and inflation is stagnant at the existing level. The present value of depreciation allowances on old capital is deducted from the expected flow of allowances from the new capital to approximate the marginal Q. Both these studies provide strong support for Tobin 'q' theory in explaining aggregate investment behaviour.

3.2 Criticism of the valuation model:

Despite the appealing characteristics of the valuation model, either in terms of theory behind it or empirical evidence, there are a number of problems which one has to take into consideration when applying this model to explain investment behaviour.

Similarly to the neoclassical model, in the 'Q' formulation the effects of tax exhaustion cannot be directly analysed. From equations (5.3.14) and (5.3.15) the effective corporation tax rate has to be positive or zero. If the denominator is unity then this ratio will be equal to the numerator. If, on the other hand, it is lower than zero, then the valuation ratio would be underestimated. In a sense, this case may prevent firms from investing, but the extent may be overestimated. As opposed to the Jorgenson model, the present value of allowances may be negative for this ratio, if the firm is not expecting to recover capital allowances. However, the ratio may be underestimated if negative values of the present value of allowances are included.

Tobin 'q' theory assumes strong relationship between the market and the behaviour of the firm. In particular, shareholders invest in a company for the sole reason that the company is prosperous and will have good investment opportunities. The market efficiency has been widely accepted in the financial literature (see Fama (1976) for a summary of studies which support the hypothesis of market efficiency for common stock). It may, however, be the case that share price is not determined by long term expectations. If the market capitalisation of the firm has some speculative content, then the 'q' theory may not be a correct measure for investment (Malinveaux 1982). Furthermore, some firms may be underpriced, for instance, because their dividend pay-out ratio is low (recently Nickell and Wadhwani (1987) found that the market attaches too high a weight to current dividends), or because of inflation illusion (Modigliani and Cohn 1979). Moreover, if the expected investment opportunities are the main determinants of the market value of the firm, then one would expect a relative stability in the share prices because the firm does not change substantially and frequently its investment programmes. However, empirical evidence supports the overreaction hypothesis (De Bondt and Thaler (1985) and Shiller (1981a, 1981b))

The theory states that investment is related to marginal value of firm, i.e., the increase in the market value as a result of an increase in a unit investment. In reality, however, only average 'q' is observable. Theories that approximate marginal 'q' for average 'q' assume either, that the market has already discounted the new investment, or that the new project is marginal and would not change substantially the value and the risk position of the firm. If this is the case, then the 'q' model may only be limited to the analysis of such investment projects, which, in fact the weighted average cost of capital does. Hayashi (1982), on the other hand, showed that if the production function and adjustment cost functions are homogeneous of first degree, then average and marginal Q are the same.

The theory states that investment rate is only related to current level of 'q', while empirical studies have included, in addition, lagged values. If the lags were not included, then the Durbin-Watson statistics becomes very low (Von Furstenberg (1977), Oulton (1981), Abel (1979), Abel and Blanchard (1983), and Poterba and Summers (1983)). In addition, for the investment function, if both q and current profit rate are incorporated as explanatory variables, investment rate may be more correlated to the latter than to the valuation ratio (Abel and Blanchard (1983)). This means that companies are more inward looking in their investment decisions than regulated by the stock market.

Despite these reservations as to the validity of the valuation ratio, empirical studies have found it to fit the aggregate data quite well. This model has not, however, been applied at company level in the UK. In the US Salinger and Summers (1983) found strong relationship between investment and Q for individual companies on a time series basis. Aggregation bias is more pronounced for this model because all the determinants of 'Q' are situation specific characteristics of each individual company and cannot be considered to be the same. In chapter 7 these issues of aggregation bias are discussed together with an estimation of the valuation ratio for each firm in the sample.

4. Conclusion:

From this review of the literature we can conclude that there are many econometric models that have been applied to provide an empirical analysis of the investment behaviour. Attention is focussed more on these models that have analysed the impact of taxation at the aggregate. Models that used company data did not analyse the impact of taxation. There is no direct preference for one model as opposed to another to analyse tax impact on investment. In addition to these specifications reviewed above a number of other specifications are used by the macro-econometric models (Wallis *and al.* (1984), Chirinko and Eisner (1984a, 1984b)). The choice of a particular model seems to be determined more by what is being analysed.

Studies that compared the performance of the different macro-econometric models appear to be unconclusive. Clark (1979) using US data and Savage (1977) using UK data found that output is the primary determinant of business fixed investment. On the other hand, Feldstein (1982), using US data, found some preference for the neoclassical model, and Jenkinson (1981) supports the view that models with explicit treatment of profitability influences (neoclassical and valuation models) perform better than the simple accelerator model. Using aggregate UK Industrial and Commercial Companies data we obtained similar results from the valuation model and the neoclassical.

In the next two chapters the impact of taxation is analysed using both the neoclassical model and the valuation ratio adjusted for taxation. In addition, the accelerator model will be tested in order to determine the impact of tax exhaustion which cannot be analysed through the neoclassical model or the Tobin q.

CHAPTER VI

EFFECTS OF TAXATION ON INVESTMENT: NEOCLASSICAL MODEL

The theoretical review of the literature has shown that most previous empirical studies of investment behaviour have concentrated on aggregate data despite the microeconomic origin of the model. These studies have assumed that all the firms in the economy have their profits taxed at the standard corporation tax rate and that they are all able to claim capital allowances on their investment expenditure. Therefore, their objective in determining the impact of taxation through the neoclassical model is more to do with formulating some macro-economic policies. They assume that firms will have unanimous response to any change in the corporation tax system. However, as demonstrated in chapter 2, firms are different in their tax position. Therefore, their behaviour cannot be assumed to be homogeneous[1].

This study attempts to fill in this gap in the literature by providing an analysis of the relationship between investment expenditure and taxation using the neoclassical model for a number of individual companies. In this chapter the modified investment equation together with the empirical results are dealt with. The first section describes the different variables used to explain investment behaviour and comments on the reasons for their inclusion. In section 2 the methodology employed to obtain the empirical results is considered

1. Thomas (1985) analysed the problems of the aggregation of the production function and other likely problems of aggregation.

and the construction of the required data is described in section 3. Section 4 presents the results obtained together with their analysis and the possible explanations given to their coefficients.

1. The Investment Equations :

The econometric model applied to test the investment behaviour of the sample of firm is based on the Jorgenson (1963) model. The choice of this specific model is due to the fact that, as seen above, it is derived from an optimisation function and allows for the tax variables to be incorporated as an element in the determination of the firm's desired level of capital stock. Furthermore, this model, as opposed to the valuation ratio, avoids the problems caused by the fluctuations in the value of the firm due possibly to some speculative reasons. The impact of taxation on investment behaviour is analysed through the user cost of capital as it is an element in the desired capital stock, which, in turn, explains the level of investment expenditure (Hall and Jorgenson 1967, 1971).

However, this specification assumes that the response of investment to the different components of the desired capital stock is the same. Alternatively, the optimal capital stock may be split into its different components. The use of a logarithmic specification results in a substantial loss of observations. Instead, the Savage (1977) framework, where we assume that the desired capital stock is approximated by an additive combination of its components, is employed. In this way the coefficient of the tax variable may be obtained. In addition, the accelerator model may be used to test for the impact of tax exhaustion on the level of investment expenditure.

1.1 Hypotheses tested :

From the above theoretical review of the literature, a number of hypotheses that need to be empirically tested can be drawn :

1) The empirical support of the neoclassical model in the previous studies implies that a combination of factor prices and level of output exerts a strong influence on the level of capital expenditure. In particular, this chapter will examine the positive relationship between investment and change in the desired capital stock. If this relationship is established, then we can conclude that taxation affects investment, because, in this specification, we constraint investment to have the same elasticity with respect to all of the components of the relative price term.

2) Capital allowances and corporation tax rates have a direct relationship to the level of investment. The former tends to encourage investment expenditure, because the more the company expects to claim additional allowances, the lower the actual after tax cost of the equipment, and as a consequence the more investment is undertaken. On the other hand, corporate tax rate reduces the after tax net present value of a particular project, therefore, discourages the firm from financing some marginal capital equipment. The combination of these two elements allows one to test for :

a) whether corporation tax exerts any effect on investment expenditure;

b) whether an increase in allowances and/or a reduction in the tax rate would encourage investment expenditure.

3) A firm is not likely to increase its investment expenditure if it is

in a position where it cannot claim the capital allowances, either in the near future or in the long-term.

In order to test for these hypotheses, the following set of linear investment equations are constructed :

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_0 + \alpha_1 \Delta \frac{K^*_{i,t}}{K_{i,t-1}} + \alpha_2 \frac{1}{K_{i,t-1}} \qquad (6.1.1)$$

$$\frac{I_{i,t}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{\Delta \frac{P_{q,i,t}}{P_{k,i,t}}}{K_{i,t-1}} + \beta_2 \frac{\Delta\left(1-A_{i,t}\frac{)}{(1-\tau_{i,t}}\right)}{K_{i,t-1}} + \beta_3 \frac{\Delta r_{i,t}}{K_{i,t-1}}$$
$$+ \beta_4 \frac{\Delta Q_{i,t}}{K_{i,t-1}} + \beta_5 \frac{1}{K_{i,t-1}} \qquad (6.1.2)$$

$$\frac{I_{i,t}}{K_{i,t-1}} = \gamma_0 + \gamma_1 HT_{i,t} + \gamma_2 TAX_{i,t} + \gamma_3 \Delta \frac{Q_{i,t}}{K_{i,t-1}} + \gamma_4 \frac{1}{K_{i,t-1}} \qquad (6.1.3)$$

Where $\frac{I_{i,t}}{K_{i,t-1}}$ = "additions to other tangible assets" of firm i at time t, deflated by the opening level of stock of plant and machinery, at 1980 prices;

Δ = change from period t-1 to t;

$\frac{[K^*_{i,t} - K^*_{i,t-1}]}{K_{i,t-1}}$ = the period change in the desired capital stock;

$\frac{1}{K_{i,t-1}}$ = the inverse of the capital stock of plant and equipment at the beginning of the period at constant 1980 prices;

$Q_{i,t}$ = level of output;

$r_{i,t}$ = cost of equity capital;

$A_{i,t}$ = present value of capital allowances;

$\tau_{i,t}$ = effective corporation tax rate before allowing for the capital allowances;

$\frac{P_{q,i,t}}{P_{k,i,t}}$ = relative price of the price of output over the price of capital;

$HT_{i,t}$ = a dummy variable reflecting the fact that a company i is tax exhausted for more than three consecutive years;

$TAX_{i,t}$ = dummy variable which defines tax exhausted companies at time t;

The signs of the explanatory variables are expected to be as follows

$\alpha_0 > 0$; $\alpha_1 > 0$; $\alpha_2 > 0$;

$\beta_0 > 0$; $\beta_1 > 0$; $\beta_2 < 0$; $\beta_3 < 0$; $\beta_4 > 0$; $\beta_5 > 0$.

$\gamma_0 > 0$; $\gamma_1 < 0$; $\gamma_2 < 0$; $\gamma_3 > 0$; $\gamma_4 > 0$;

1.2 Definition of the Variables :

The explanatory variables are defined as :

a) Hypothesis 1 implies that capital expenditure during the period acts at reducing the gap between the optimal capital stocks of two successive periods. The desired capital stock, in turn, is determined by the desired level of output, price of output and the user cost of capital, i.e.

$$K^* = \alpha \frac{P_q Q}{c} = \alpha \frac{P_q Q}{P_k (r + \delta)(1 - A)(1 - \tau)^{-1}} \qquad (6.1.4)$$

The higher the value of output, (P_q), the higher the desired capital stock. On the other hand, the higher the user cost of capital, c, the lower the desired level of capital stock because the more expensive is the acquisition of capital equipment.

Corporation tax factors are incorporated through the present value of allowances (A) and the effective corporation tax rate (τ). The factor $P_k(1-A)$ measures the actual cost of purchasing the equipment. If the firm is able to claim the whole cost of the asset purchased in the first year against tax, then it acquired the equipment free of charge.

Any proportion of A represent a subsidy to capital expenditure. The user cost of capital is also increased by the required rate of return by shareholders, r, and by the depreciation rate, δ.

Because of the relatively small number of time series observations (12 years), no attempt has been made to compute the elasticity of substitution between capital and labour. Instead, the Cobb-Douglas production function is assumed for all the companies in the sample, thus constraining the elasticities of the investment with respect to the output and relative prices to be equal. Moreover, it is assumed that output and the user cost of capital affect the desired capital stock in the same way, in other words, a percentage change in the present value of the allowances would affect the desired capital stock in the same way as the same change in the cost of finance or the economic depreciation. These are probably strong assumptions given that the firms in the sample are not only of different sizes, but spread into different industries as well.

b) When the latter assumption is relaxed the original neoclassical specification is reformulated in such a way as the elasticity of each component of the desired capital stock may be estimated individually. In order to split the neoclassical formulation into its different components one need to use the logarithmic specification because the user-cost of capital is a product rather than a sum. However, because of the relatively large number of negative and zero values, this specification has resulted in a substantial loss of observations. Instead, the specification used by Savage (1977) is employed here. It assumes that the optimal capital stock may be approximated by an additive combination of the relative price of output and capital, $\frac{P_q}{P_k}$, tax factor, $(1-A)/(1-\tau)$, cost of capital, r, and the level of output, Q. The desired level of capital stock becomes as follows:

$$K^* = \alpha_1 \frac{P_q}{P_k} + \alpha_2 \frac{(1-A)}{(1-\tau)} + \alpha_3 r + \alpha_4 Q \qquad (6.1.5)$$

and the investment model may be transformed as:

$$\frac{I}{K_{-1}} = \frac{\beta_5 + \beta_1 \Delta \frac{P_q}{P_k} + \beta_2 \Delta \frac{(1-A)}{(1-\tau)} + \beta_3 \Delta r + \beta_4 \Delta Q + \beta_0 K_{-1}}{K_{-1}} \qquad (6.1.6)$$

$$= \beta_0 + \beta_1 \Delta \frac{\frac{P_q}{P_k}}{K_{-1}} + \beta_2 \frac{\Delta \frac{(1-A)}{(1-\tau)}}{K_{-1}} + \beta_3 \frac{\Delta r}{K_{-1}} + \beta_4 \frac{\Delta Q}{K_{-1}} + \beta_5 \frac{1}{K_{t-1}} \qquad (6.1.7)$$

If corporation tax does not affect the level of investment expenditure, then the coefficient of the tax variable, β_2, will be insignificant. On the other hand, if corporate taxation does have an impact on the level of investment, then this variable is expected to be negatively correlated to the investment rate.

c) Hypothesis 3 predicts that the particular tax position the firm is in may influence the level of investment. Specifically, if the firm is not likely to be able to claim tax rebates on its investments it is expected to be refrained from undertaking some projects that are marginal. The basis for such decision is the effective corporation tax rate the firm will have to pay before undertaking any additional investment. If it is in tax exhaustion position then the firm is expected to have a lower level of capital expenditure.

If a company is tax exhausted, it may be in this position for just a short time period, in which case current allowances could be carried forward and claimed against future profits. What is more of interest to investment decision is whether the company is not able to claim past allowances at all. If this is the case, then the cost of the asset will be higher, and this possibility may discourage the firm from undertaking some projects. In order to test for these effects, we define two dummy variables, one to measure tax exhaustion in any particular year. The other defines highly tax exhausted companies if this situation spreads over more than three years.

If, as argued in chapter 1, corporation tax is neutral, then we would expect both these dummy variables to be insignificant, i.e. not to influence the level of investment undertaken. On the other hand, if corporation tax distorts the level of investment in plant and machinery, then these variables are expected to be negatively correlated to the level on investment expenditure.

2. Methodology:

Cross-sectional tests of the neoclassical model are very rare. The reason given by Jorgenson and Siebert (1968) for not using cross-sectional data is the difficulty in specifying the lag structures correctly. However, at company level, the availability of a relatively very small sample period and the existence of serial correlation may make estimates of time-series data biased. Using cross-sectional data could, however, lead to some problems. In particular homogeneity of the sample is assumed. Eisner and Strotz (1963) argue that investment of a small firm cannot be compared to the level of investment of a large firm, and Meyer and Glauber (1964) overcame this problem by carefully selecting their sample. Furthermore, the estimates obtained from cross-sectional data may not be generalised as they refer to only one period of time and they could stem from only an unrepresentative year. But such problem may be reduced the higher the number of consecutive years in the sample period. Kuh (1963) argued that cross-sectional data may be a poor way for analysis when dynamic disturbances are present and unaccounted for by the model. In this case, the accelerator model which makes investment dependent on only the level of output is superior to the neoclassical model. However, the likely bias depends on what is analysed. Kuh was studying the determinants of investment from the aspect of macro dynamic model while Eisner and Strotz argue that cross-sectional analysis may indicate not the determinants of aggregate investment but rather by which firm investment is undertaken.

This study attempts to explain investment behaviour of a number of individual companies by using the neoclassical model as developed by Jorgenson. First, all the firms are taken together to form a pooled cross-sectional time-series estimates. This method is efficient only if the variables have not fluctuated substantially during the sample period. Given the relatively long sample period (11 years) it is difficult to imagine that the variables have been stable. Because of the low level of the degrees of freedom, there was no attempt to obtain time-series estimates. Instead, a set of cross-sectional estimates are computed for each year from 1973 through to 1983. The advantage of cross-sections is that, as opposed to time series, collinearity between the variables may be reduced and it allows for the effects of a wide variation in the dependent variable to be better explored. For instance, a change in the desired capital stock might indicate the likely consequence of a movement in the tax rate which could not easily be predicted from time series. Cross-sections estimates are expected to approximate long-run relations but annual estimates may suffer from short run disturbances as a consequence of incomplete adjustment[2].

Given that the firms in the sample are of different sizes, as measured by their capital stock or sales, using absolute values may lead to the problem of heteroskedasticity. In order to obtain unbiased coefficients, all the variables that are in value terms are deflated by the level of capital stock. Thus investment, for instance, instead of being the actual value of investment expenditure, is expressed as a proportion of the existing capital stock, so that comparison may be made against other companies without bias of size.

Using OLS for pooled cross-sectional and time series estimates may lead to two main problems. The least squares estimators of the regression coefficients are unbiased and efficients only if the specification of the model represents all what is supposed to be known about the regression equation and the variables involved. If the disturbance in the investment function for one equation is correlated with the disturbances in the investment functions of other equations then the OLS estimates may be biased. If for instance the regression coefficients in each equation are the same as the regression coefficients in any other equation, then the whole data may be treated

2. See Kuh (1963) pp. 175-188 on such points.

in a single equation and the observations would represent pooled cross-section and time series data. However, if this is not the case, then the data is divided into a system of M equations known as the seemingly unrelated regressions (SUR) equation. The estimation technique is developed by Zellner (1962). This method estimates a set of regression equations, thus allows each unit to be described by one equation from the system. It thus reduces the possible correlation between the different disturbances of different companies.

When pooled data is used we are constraining the coefficients of single years equations to be the same for all the years. This, however, may not be the case if the explanatory variables and the dependent variables have changed significantly during the sample period, and this movement may not be in the same direction. In order to test simultaneously the validity of h restrictions, i.e. the hypothesis that all the coefficients of the explanatory variables are equal through the years, we compute F distribution with (h,n-k) degrees of freedom as (Koutsoyiannis (1977) p. 172) :

$$F^{*} = \frac{(SSR_{r} - SSR_{u})/h}{SSR_{u}/(n-k)} \qquad (6.2.1)$$

Where n-k refers to the degrees of freedom associated with the unrestricted equation;

SSR_{u} = Sum of squared residuals obtained when coefficients vary through time;

SSR_{r} = Sum of squared residuals when coefficients are restricted to be equal;

n is the sample size;

k is the number of unrestricted parameters.

We reject the restrictions if the proportionate increase in the sum of squared residuals resulting from their imposition is sufficiently large, i.e

$F^* > F_c$

Where c is the level of significance chosen.

3. Data Construction :

Most data required to estimate the neoclassical model is obtained from Extat data bank. Some other data sources are needed to compute such variables as the cost of capital and the price deflator. In the present section the methods used to estimate all the necessary variables are described together with some reservations as to the availability of data and the techniques employed.

3.1 Estimation of investment and capital stock variables :

Investment is taken as additions to *other tangible assets* [3], i.e. plant and machinery. The neoclassical model specifies that the variables that are in value terms have to be taken at constant prices. Because of the unavailability of the price index to use to deflate the value of property which is at historical cost *additions to property* are not included. Thus, thereafter, the term investment will refer to additions in plant and machinery only. This is deflated using the 'Price Index Numbers for Current Cost Accounting' (1982) and Business Monitor (1986) to obtain investment in plant and machinery

3. In Extat tangible assets are classified as property and other tangible assets. The former relates to land and buildings while the latter includes plant and machinery.

at 1980 prices.

From the Extat data bank, the following relationship is found to define the evolvement of the capital stock through the period :

$$K_t = K_{t-1} + MPM_t - MD_t \qquad (6.3.1.1)$$

Movements in plant and machinery (MPM) include :

a) Additions,

b) Disposals,

c) New subsidiary companies,

d) Subsidiary companies disposed off,

e) Reevaluation,

f) Currency change,

g) Other.

Movements in depreciation (MD) during the period contain :

1) Charge for the year,

2) Adjustment on disposals,

3) New subsidiary company,

4) Subsidiary company disposed off,

5) Reevaluation,

6) Currency change,

7) Other.

The depreciation rate is computed as the ratio of the depreciation charge for the period (DEP_t) over the opening balance of the capital stock (K_{t-1})[4], i.e.,

$$\delta = \frac{DEP_t}{K_{t-1}}$$

Given that the denominator of this ratio is valued at historical cost[5], inflation may affect the rate obtained[6]. However, if the depreciation expense is calculated on the basis of the capital stock at historical cost, then this rate may be independent of the inflation rate. Moreover, using this method it is assumed that all the capital stock in the company is homogeneous, depreciates at the same rate and that companies use the same method of depreciation, independently of the age and nature of the existing capital stock. In Theory, in order to compute the depreciation rate, one needs to know the length of life of each constituent of the capital stock, then for each year, compute the corresponding economic depreciation. However, given that the data available does not distinguish between the different components of the capital stock and does not give the relative asset life of each element, the average depreciation rate, as computed above is thought to be the closest approximation[7]. The above equation (6.3.1.1) of the capital stock becomes :

$$K_t = NMPM_t + (1 - \delta)K_{t-1} \qquad (6.3.1.2)$$

Where $NMPM_t$ is the net movements in plant and machinery during the period computed as the difference between movements in plant

4. Mayer (1982a) compared the alternative techniques that can be used to estimate depreciation rate from the published accounts found that the ratio of depreciation to gross capital stock to yield the most consistent results.
5. ICA (1982) reported that many companies surveyed use the same asset lifes in computing both the historical cost accounts and current cost accounts.
6. Hulten and Wykoff (1981) found that inflation does affect the rate of depreciation in the sense that companies use higher rate to depreciate more quickly their equipment. The subject of the effects of inflation on depreciation has been dealt extensively in the literature. See for instance Baxter (1971) and Auerbach and Jorgenson (1980).
7. The average life of the assets is found to be approximately 10 years (7 to 10 years in ICA (1982) survey). An attempt has been made to use the Cambridge. Department of Applied Economics data bank to compute the depreciation using the above method, but the differences in the definition of the data made this computation impossible.

and machinery during the period and movements in depreciation without the depreciation charge for the year (which is incorporated in δ).

In order to convert the historical cost capital into constant prices net movements in plant and machinery are deflated into 1980 prices using the relevant industry price index for each firm. Firms are classified into different industries according to the Standard Industrial Classification (SIC). It is, however, assumed here that a firm is operating only in one industry, while in reality many of them may be diversified. Furthermore, the CSO computes the price index on the basis of plant rather than firm. This is, however, considered the best data available. It is expected that a large amount of investment is directed into expansion and depreciation in that relevant industry. The significant correlation between the price indices of all industries may not make this assumption very strong.

The bench-value of capital stock at replacement cost is taken from the current cost accounting published accounts which is in most case in 1980. The previous and post- this year's values are computed by cumulating the deflated investment and by using the rate of depreciation as computed above. Some companies have not produced their current cost accounts. Their capital stock at 1980 prices was not estimated.

3.2 Computation of the cost of capital :

The cost of capital is taken as the cost of equity. It is assumed that the firm would undertake investment projects if the returns generated by such investments increase shareholders' wealth. There are two main different ways of computing the required return on equity capital : The dividend valuation model and the capital asset pricing model (CAPM).

The first one assumes that the future flow of annual dividends is expected to be in perpetuity and computes the cost of capital on the basis of the ratio of dividends over the market value of the firm. However, if the company does not pay any dividends (which is the case of a number of firms in the sample) then this method would fail to estimate correctly the cost of capital. Furthermore, because of the fluctuations in share prices, due possibly to speculative reasons, the cost of capital obtained from this method fluctuates significantly. Alternatively, we can assume that dividends increase by a certain amount every year. Then, instead of computing the cost of equity using only the ratio of dividend to price, we add a term reflecting the growth rate in dividends to the dividend yield. In this case, even if this latter is zero the cost of capital would still be equal to the growth rate which may be computed by taking the average past rate of growth in dividends and assuming that this rate will continue unchanged in the future, or by using the Gordon model in which case the dividend growth rate is a function of the rate of return yielded by investment projects. While the latter cannot be applied because it explicitly assumes an all equity company, the average dividend rate resulted in some unrealistic values for the cost of capital[8].

8. The average dividend growth rate over the sample period is computed as the average of the ratio of current level of dividend per share over lagged value, *minus* 1. The values of the growth rate obtained range from -0.6 to 0.7.

The capital asset pricing model (CAPM) is used to estimate the cost of equity. It states that in market equilibrium the expected return on a security is the risk free rate of interest plus a risk premium determined by the level of market risk :

$$R_s = R_f + \beta_s (R_m - R_f) \qquad (6.3.3)$$

Where R_s = a one period expected return on security s;

R_f = the risk free rate of return;

R_m = the market expected return;

$\beta_s = \dfrac{cov(\tilde{R}_s, \tilde{R}_m)}{var(\tilde{R}_m)}$ = the measure of systematic risk, with $\hat{R}_s$, $\tilde{R}_m$ the rates of return on the security and on the market respectively.

The basic idea is a computation of β which measures the sensitivity of the share price to the movements in the market (R_m). This model can be used in capital budgeting because the market value of the firm is the present value of its investment schedule. It is, thus, assumed that project beta is equal to the average beta of the firm. This model is superior to the previous ones as it allows for the risk element. It is, however, based on some restricted assumptions (Jensen 1972) :

(i) all investors are single period, expected utility of terminal wealth maximisers, who chose among alternative portfolios on the basis of the mean and variance of portfolio returns;

(ii) all investors can borrow and lend an unlimited amount at an exogenously given risk free rate of interest;

(iii) all investors have identical subjective estimates of the means, variances and covariances of returns among assets, i.e. investors have homogeneous expectations;

(iv) all assets are perfectly divisible and perfectly liquid with no restrictions on short sales of assets;

(v) There are no transaction costs and no taxes;

(vi) all investors are price takers;

(vii) the quantities of all assets are given;

and also (viii) all securities in the market are marketable (Roll 1977).

While some of these assumptions, such as transaction cost and taxation, may be relaxed, the homogeneity in expectations of shareholders for instance, has been refuted (Blume and Friend 1975). Furthermore, to have the exact CAPM relationship (equation 6.3.3) the market portfolio efficiency condition should hold. In other words, if the 750 actuaries ordinary share index used to proxy the market return is not on the actual efficient frontier, then the required return by shareholders is not related to the systematic risk as the CAPM asserts (Roll 1977). In this study, we recognise this possibility, but we use the 750 actuaries ordinary share index as a proxy for the market return.

More importantly is the fact that when CAPM approach is related to fixed investments which are held for a period of more than one year, one is faced with the issues of whether and to what extent project beta changes over time. Empirical studies have found that security betas are not stationary (Dimson and Marsh 1983). Such fluctuations in individual security betas may arise from changes in the firm's capital structure (Hamada 1972), but this, normally, would not affect significantly project betas. Gonedes (1973) found that, while such betas may not be constant through time, they do not change dramatically over 5 to 10 years. Empirically, it was found that the stability of beta increases the longer the estimation period (Dimson and Marsh 1983) and the smaller the estimation intervals (Diacogiannis 1986).

Another problem with using the CAPM to proxy the cost of equity is the possibility that some shares may be subject to thin trading. According to Dimson (1979) infrequent trading results in a bias which comes from the possibility that the prices recorded at the end of a time period may represent the outcome of a transaction which occurred earlier in or prior to the time in question. To account for this problem, multiple regressions of security returns have to be run against lagged matching and leading market terms and consistent betas may be obtained by aggregating the slope coefficients from the regression. However, Theobald (1983) argued that even if this procedure eliminates the effects of nontrading on parameter estimators, the residuals are still affected by the thin trading problems which are still present in the return variables themselves. Instead, longer differencing intervals may be preferable at this specification reduces the problem of allocating price movements to particular periods.

Although the above assumptions may not hold in reality, this model appears to be the best available to estimate the cost of capital. For the present study, 3 different specifications have been tried to estimate beta for each company and for each year in the sample period. The monthly log returns extracted from the London Share Price Database (LSPD) are used. The 750 actuaries ordinary share index is used as market return. Betas for calendar years were obtained using ordinarily least squares (OLS)[9]. Because of the substantial loss of the degrees of freedom, the monthly is preferred to the quarterly returns. The independent variable is the return of the security over 5 years (thus making 60 observations) preceding the last month of the period. The Dimson's approach was first followed for all companies, assuming that if the company is not subject to thin trading then the coefficients of the lags would be very small and insignificant. Betas were then obtained as the sum of the 11 coefficients. An alternative method was to use only lags without corresponding leads. Finally, the explanatory variable was defined only as the corresponding market return without lags or leads. It is important to concentrate on the stability of beta when choosing between the estimation methods. This is because of the fact that our analysis is based on the pooled data and also, even in cross-sectional, the seemingly unrelated regressions technique takes account of the changes through the years. If beta is not stable, then the cost of capital obtained would not be stable, as a consequence the user cost of capital used in the neoclassical specification would fluctuate from one period to another (see Appendix I for a detailed comparison between betas obtained from these three methods and their consequence on the changes in the cost of capital). In terms of stability of betas through years the last method appeared to yield the most consistent results than the first two specifications.

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9. The OLS technique may not, however, be the best method to estimate beta, but the relative differences between this technique and other alternative methods is not significant as far as the autocorrelation and heteroscedasticity is concerned (Theobald 1980) while the stationarity is corrected by the use of a moving series of parameter estimates.

The cost of equity is then arrived at by using equation (6.3.3). The risk free rate, R_f , is estimated using the monthly treasury bill rate and the market return is calculated on the basis of the London 750 ordinary shares index. Based on the idea that the market returns are supposed to reflect the *expected* returns investors would think of getting by investing in the market, and that they would not expect large fluctuations in the return on the market portfolio, the average risk free rate and market return over the whole sample period (15 years) are used. These have resulted in the risk free rate to be equal to 10.03 per cent and the market return to be set equal to 12.312 per cent[10].

3.3 Other explanatory variables :

The desired capital stock is function of the value of output and of the user cost of capital. The expected value of output is approximated by current sales. Change in the value of stock was not taken into account because a high level of stock may be due to overproduction rather than what can be sold in the market. To compute the value of output at constant 1980 prices, sales were deflated using an average stock 'Price Indices for Stocks Held by Specific Industries' CSO (1982, 1986). This index is also based on particular stock rather than on the total stock the firm possesses. Given the non-availability of the different components of stocks, this index is used as a proxy, thus assuming that all the stock relates to the central activity of the firm.

10. Weston and Brigham (1979) used an average over 16 years to compute both the market return and the risk free rate of return.

To estimate the user cost of capital we need also the computation of the price of capital, the depreciation rate and the tax variables. The price index for the current cost accounting as published in the CSO is used to proxy the price of capital for each company. Following King and Fullerton (1984), the economic depreciation is computed as being twice the straight line depreciation.

The tax variables are computed from the tax model (see chapter 1). Firms are assumed to be divided into 3 categories. They may, either, be in tax paying position if their effective corporation tax rate is positive or be tax exhausted in which case they are not paying tax. Alternatively, they may be highly tax exhausted if their taxable profit is negative or zero in 3 successive years. Dummy variables are defined to capture these effects. For the tax exhausted, a company is assigned a value 1 if its taxable profit is zero or negative and zero otherwise. For the third category, the dummy variable is equal to 1 if the firm is tax exhausted in 3 consecutive years or more[11]. For this third category, it is assumed that none of the companies in the sample is tax exhausted in 1971, so that to avoid considering this dummy variable as missing in 1973.

Following Melliss and Richardson (1976), the value of the incentive has been calculated in discounted cash flow terms. This method assumes that the tax system would not change over the life of the

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11. Firms are normally able to claim tax reliefs for a period of up to six years (chapter 1), but if all these years were taken into account this variable would appear only starting from 1977. For computation purposes it is assumed that a firm with negative or zero taxable profit in a period of three years may be seen as highly tax exhausted.

asset. The present value of initial and depreciation allowances are computed in such a way as to reflect the opportunity cost to the shareholders. The discount rate used then is the cost of equity as computed above. The effective corporation tax, as calculated for each company, takes already account of the capital allowances. In order to isolate the impact of capital allowances it is necessary to compute the effective tax rate without accounting for these allowances. In this way double counting of capital allowances are avoided.

For the sample period, incentives for plant and machinery were of the form of initial allowance and depreciation allowance. These allowances are set against the taxable profit. For tax purposes, depreciation on plant and equipment is on a reducing balance basis. For each unit of capital expenditure, the present value of these allowances may be computed as :

$$NPV = \frac{\tau}{(1+r)^l}\left|(R+d) + \frac{d(1-d-R)}{(1+r)} + \frac{d(1-d)(1-d-R)}{(1+r)^2} + \cdots\right|$$

or

$$NPV = \frac{\tau}{(1+r)^l}\left|(R+d) + \frac{d(1-d-R)}{(1+r)}\sum_{i=0}^{n}\left(\frac{1-d}{1+r}\right)^i\right|$$

Assuming that n tends towards infinity, then this equation becomes :

$$NPV = \frac{\tau}{(1+r)^l}\left|(R+d) + \frac{d(1-d-R)}{(r+d)}\right| \qquad (6.3.3.1)$$

Where τ is the effective corporate tax rate before deducting the allowances;

R = initial allowance;

d = annual reducing balance writing down allowance;

r = discount rate (CAPM);

l = lag in tax payment assumed to be 1 year and 7 months;

NPV = Net present value per unit of capital cost of an asset life of n years.

For industrial buildings, on the other hand, depreciation is calculated on a straight line basis. Using the same notation as above, the formula for the present value of allowances is as follows :

$$NPV = \frac{T}{(1+r)^l}\left[(R+d)+d\left(\frac{(1+r)^N-1}{r(1+r)^N}\right)\right] \qquad (6.3.3.2)$$

Where $N = [\frac{1-R-d}{d}]$ and d is now the annual straight line allowance in each year, i.e. a fixed percentage of the original capital sum.

The present value of capital allowances (A) is computed as a weighted average of equation (6.3.3.1) and (6.3.3.2) on the basis of the relative proportion of investment in plant and machinery and in property.

4. Empirical Results :

A pooled cross-section time series analysis together with cross-sectional analysis are performed. The former encompasses the 11 years and all companies in the sample[12], while the latter deals with companies' investment for each year separately. Using the Chow test, as described in the methodology, it is found that the pooled results

12. Because of the number of missing values the sample is reduced from 109 observations per year to an average of 84. Furthermore, since the SUR method computes the regressions in the same time, an equal sample period has to be taken, thus reducing further the number of companies to 71 per year.

may be biased. the investment equation changes substantially from one year to another. It is, therefore, necessary to concentrate more on the cross-sectional results. The following table reports the results of estimating the original neoclassical investment function using cross-sectional and pooled data.

TABLE 6.1. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_0 + \alpha_1 \Delta \frac{K^*_{i,t,t-1}}{K_{i,t-1}} + \alpha_2 \frac{1}{K_{i,t-1}}$$

YEARS	COEFFICIENTS α_0	α_1	α_2	σ_u σ_r	$F_{3.68}$
1973	0.069	0.0025*	851*	0.341	129**
	(1.68)	(4.30)	(48.52)	0.882	
1974	0.176*	-0.0003	220*	0.270	7.99**
	(5.28)	(-0.308)	(4.902)	0.314	
1975	0.09*	-0.0002	493*	0.196	1.74
	(3.39)	(-0.43)	(7.39)	0.203	
1976	0.078*	0.0006*	398*	0.111	1.98
	(5.52)	(2.04)	(10.59)	0.116	
1977	0.125*	-0.00002	207*	0.119	34.27**
	(8.07)	(-0.042)	(5.78)	0.184	
1978	0.15*	0.0007	249*	0.161	33.14**
	(7.45)	(1.949)	(12.66)	0.253	
1979	0.203*	-0.0002	407*	0.460	1.38
	(3.34)	(-0.209)	(4.29)	0.474	
1980	0.181	0.0007	212*	0.156	39.06**
	(9.22)	(1.60)	(10.59)	0.257	
1981	0.156*	-0.0002	128*	0.153	159**
	(8.27)	(-0.55)	(11.05)	0.433	
1982	0.177*	0.00004	193*	0.313	11.41**
	(4.46)	(0.08)	(6.078)	0.384	
1983	0.182*	0.003*	239*	0.212	22.98**
	(6.57)	(2.83)	(9.63)	0.300	
POOLED	0.083*	0.0009*	465*		
	(6.68)	(8.45)	(23.36)		

Notes: Trace matrix of pooled is 752.62 and for cross-sectional 757.1

t-statistics in brackets.

* significance at 5% level, $t_c = 1.960$

** significant at 5% level, $F_{3.68} = 2.760$.

σ_u and σ_r are the standard error of the cross-sectional and pooled, respectively.

Number of Observation 71 for cross-sectional and 781 for pooled.

TABLE 6.2. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_0 + \alpha_1 \Delta \frac{K^*_{i,t,t-1}}{K_{i,t-1}} + \alpha_2 \frac{1}{K_{i,t-1}}$$

YEARS	COEFFICIENTS α_0	α_1	α_2	$\bar{R}^2$	σ
1973	0.059	0.0031*	865*	0.963	0.346
	(1.398)	(4.44)	(41.7)		
1974	0.178*	0.0004	241*	0.261	0.275
	(5.131)	(0.37)	(4.31)		
1975	0.063*	-0.0009	602*	0.431	0.197
	(2.117)	(-1.23)	(7.24)		
1976	0.081*	-0.0001	322*	0.624	0.111
	(5.47)	(-0.335)	(6.398)		
1977	0.137*	-0.0008	139*	0.558	0.120
	(8.034)	(-1.105)	(2.54)		
1978	0.155*	0.0007	235*	0.589	0.164
	(7.39)	(1.066)	(10.1)		
1979	0.180*	-0.0006	479*	0.129	0.469
	(2.615)	(-0.33)	(3.35)		
1980	0.187*	0.004*	199*	0.478	0.157
	(9.08)	(2.00)	(8.08)		
1981	0.158*	-0.0002	123*	0.463	0.156
	(7.96)	(-0.24)	(7.72)		
1982	0.178*	-0.0002	189*	0.168	0.320
	(4.067)	(-0.123)	(3.99)		
1983	0.190*	0.0003	223*	0.425	0.216
	(6.359)	(1.935)	(7.28)		
POOLED	0.093*	0.0015*	501*	0.576	0.396
	(6.20)	(3.91)	(32.09)		
74-83	0.165*	0.0007	209*	0.277	0.250
	(16.17)	(0.25)	(15.84)		
73-78	0.06*	0.003*	701*	0.796	0.346
	(3.58)	(8.01)	(40.23)		
74-78	0.134*	0.0003	256*	0.403	0.190
	(12.37)	(1.01)	(13.9)		
79-83	0.187*	0.0007	172*	0.321	0.225
	(12.69)	(1.32)	(11.65)		

Notes: t-statistics in brackets, * significance at 5% level, $t_c = 1.960$

$\bar{R}^2$ = coefficient of determination adjusted for degrees of freedom,

σ = standard error of the estimates.

Number of Observation 71 for cross-sectional and 781 for pooled.

Table 6.1 and 6.2 above show that the neoclassical model does not offer a good explanation of the investment behaviour of individual companies when cross-sectional data is used. In most cases the coefficients of the change in the optimal capital stock comes with the wrong sign when the ordinarily least squares technique is used. Moreover, amongst these that are positive, only 20 per cent of them are significant. The seemingly unrelated regressions technique offers a slightly better results in terms of the significance of the neoclassical term. However, the number of these coefficients that are of the expected sign is still very low (54 per cent).

The relatively good performance of the neoclassical specification when the pooled cross-sectional time series data is used seems to be the direct result of 1973. Indeed, any regressions performed with the exclusion of this year comes without the significance of the coefficient of the change in the optimal capital stock. Moreover, the results are very sensitive to the time period used as shown by the fluctuations in the coefficients of the change in optimal capital stock when the time period is 1974 to 1978, 1980 to 1983 and when the whole sample period is taken. On the basis of the neoclassical assumptions we may conclude that corporate taxation does not exert any impact on the investment decision of the firm. These results cannot be directly compared to these obtained by previous studies using aggregate time series data. This is because the results obtained here are cross-sectional estimates, thus supposed to measure the long-term response of investment to changes in taxation, while time series measure the short term response. Moreover, the specification is very different as the variables taken are specific to the firms in the sample, and that no lags are specified.

The original neoclassical model constraints investment to have the same elasticity with respect to all of the components of the relative price term. However, if this assumption is relaxed, then these results do not necessarily mean that taxation does not affect investment expenditure, because the negative relationship between changes in the optimal capital stock and investment rate may be due to the averaging out in the other components of the user cost of capital. It is, therefore, necessary to redefine the investment equation by splitting the desired capital stock into its different components. Since the optimal capital stock is in multiplicative terms, the logarithmic transformation is appropriate. However, as argued above, this has resulted in a substantial loss of data because of the negative and zero values. Instead, the Savage (1977) specification is employed. It assumes that the desired capital stock may be approximated by an additive combination of the relative components. The results of estimating equation (6.1.2) are reported in the following tables :

TABLE 6.3. RESULTS OF POOLED AND CROSS SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_{i,t}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{\Delta \frac{P_q}{P_k}}{K_{t-1}} + \beta_2 \frac{\Delta \frac{(1-A)}{(1-\tau)}}{K_{t-1}} + \beta_3 \frac{\Delta r}{K_{t-1}} + \beta_4 \frac{\Delta Q}{K_{t-1}} + \beta_5 \frac{1}{K_{t-1}}$$

YEARS	COEFFICIENTS							
	β_0	β_1	β_2	β_3	β_4	β_5	σ_u σ_r	$F_{6,65}$
1973	0.044	22391*	52678*	0.399*	226	1539*	0.260	77.75**
	(1.36)	(4.93)	(2.18)	(9.30)	(0.53)	(5.68)	0.738	
1974	0.142*	1578*	16874	0.06	585	557	0.243	3.219**
	(4.57)	(1.994)	(1.06)	(1.914)	(1.79)	(1.61)	0.276	
1975	0.075*	1319	2852	-0.007	964*	366	0.190	3.609**
	(2.92)	(-1.02)	(0.11)	(-0.33)	(3.79)	(1.63)	0.219	
1976	0.068*	1211*	9598	0.007	825*	392*	0.102	12.406**
	(5.01)	(-2.02)	(0.76)	(1.02)	(5.71)	(3.45)	0.148	
1977	0.086*	845	-18248	0.02*	667*	349*	0.101	34.686**
	(5.98)	(0.79)	(-1.83)	(3.11)	(4.64)	(-2.66)	0.206	
1978	0.122*	93.02	15628	0.027*	357*	-152	0.111	11.164**
	(8.14)	(0.105)	(1.31)	(10.17)	(2.45)	(1.16)	0.158	
1979	0.183*	199	-35832	0.032	602	35	0.453	0.966
	(2.94)	(-0.09)	(-1.52)	(-1.78)	(1.61)	(0.127)	0.473	
1980	0.153*	484	-21746*	0.016*	520*	-273	0.155	23.797**
	(7.14)	(-0.59)	(-3.82)	(2.75)	(2.94)	(-1.72)	0.276	
1981	0.144*	490	12424	0.004	11.4	163	0.149	29.619**
	(7.61)	(-0.59)	(1.59)	(0.84)	(0.10)	(1.66)	0.286	
1982	0.122*	3131	19146*	-0.005	269	89	0.294	4.418**
	(3.12)	(1.88)	(2.87)	(-0.54)	(1.73)	(0.62)	0.348	
1983	0.192*	3.24*	2168	0.005	187	367*	0.207	11.595**
	(6.61)	(2.13)	(-0.32)	(1.18)	(-0.89)	(2.03)	0.296	
POOLED	0.085*	1.680	6518*	0.030*	-464*	763*		
	(4.58)	(1.18)	(2.90)	(13.15)	(-7.79)	(13.49)		

Notes: Trace matrix of pooled is 695.6 and for cross sectional 709.6;

t-statistics in brackets;

* significance at 5% level, $t_c = 1.960$;

** significant at 5% level, $F_{6,65} = 2.250$;

Number of Observation 71 for cross sectional and 781 for pooled.

TABLE 6.4. RESULTS OF POOLED AND CROSS SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_{i,t}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{\Delta \frac{P_q}{P_k}}{K_{t-1}} + \beta_2 \frac{\Delta \frac{(1-A)}{(1-\tau)}}{K_{t-1}} + \beta_3 \frac{\Delta r}{K_{t-1}} + \beta_4 \frac{\Delta Q}{K_{t-1}} + \beta_5 \frac{1}{K_{t-1}}$$

YEARS	COEFFICIENTS							
	β_0	β_1	β_2	β_3	β_4	β_5	$\bar{R}^2$	σ
1973	0.032	23650*	47560	0.44*	-764	-1266*	0.978	0.267
	(0.93)	(4.30)	(1.56)	(8.44)	(-1.46)	(-3.82)		
1974	0.138*	3221*	33187	0.057	617	-805	0.405	0.247
	(4.09)	(3.01)	(1.52)	(1.38)	(1.41)	(-1.73)		
1975	0.071*	-2705	25133	-0.00003	1103*	-541	0.423	0.198
	(2.57)	(-1.55)	(0.68)	(-0.001)	(3.23)	(-1.78)		
1976	0.07*	-1563	11016	0.017	766*	-370*	0.666	0.105
	(4.64)	(-1.66)	(0.55)	(1.61)	(3.54)	(-2.19)		
1977	0.087*	-846	-28980*	0.018*	643*	305	0.662	0.105
	(5.43)	(-0.58)	(-2.13)	(2.14)	(3.44)	(1.79)		
1978	0.128*	82.3	38338*	0.034*	156	-15.03	0.806	0.113
	(7.67)	(0.06)	(2.14)	(8.67)	(0.75)	(-0.08)		
1979	0.161*	-1625	-82462	-0.012	591	167	0.141	0.466
	(2.08)	(-0.38)	(-1.79)	(-0.35)	(0.84)	(0.33)		
1980	0.165*	-690	-14040	0.013	486	-261	0.460	0.160
	(6.62)	(-0.52)	(-1.59)	(1.46)	(1.79)	(-1.09)		
1981	0.143*	-1627	33991*	-0.002	239	-51.03	0.506	0.150
	(6.72)	(-1.20)	(2.51)	(-0.21)	(1.28)	(-0.33)		
1982	0.116*	-3309	40599*	0.004	212	187	0.282	0.297
	(2.51)	(-1.06)	(3.15)	(0.23)	(0.79)	(0.74)		
1983	0.214*	1.72	3951	0.007	-505	623*	0.442	0.212
	(6.38)	(0.75)	(0.41)	(1.14)	(-1.62)	(2.33)		
POOLED	0.137*	2914*	22100*	0.025*	-619*	799*	0.721	0.300
	(12.42)	(14.29)	(5.67)	(6.91)	(-7.51)	(10.96)		
1973-78	0.089*	2756*	49554*	0.062*	-558*	760*	0.866	0.260
	(6.93)	(10.05)	(6.56)	(10.74)	(-5.02)	(7.75)		
1979-83	0.192*	426	7029	0.009*	-62.9	219*	0.210	0.285
	(11.89)	(0.62)	(1.36)	(2.28)	(-0.53)	(2.10)		

Notes: t statistics in brackets.

* significance at 5% level, $t_c = 1.960$

$\bar{R}^2$ - coefficient of determination adjusted for degrees of freedom.

σ - standard error of the estimates.

Number of Observation 71 for cross sectional and 781 for pooled.

The results reported in Table 6.3 and Table 6.4 show that the modified neoclassical model performs much better than the original model in terms of the coefficient of correlation, standard error and trace matrix. The coefficient of the tax variable, β_2, is not, however, always significant. It comes of the expected sign in about 30 per cent of the cases, and out of these, around 50 per cent are significant. Moreover, when the pooled data is used, this coefficient is significantly uncorrectly signed. However, the high significance of the Chow test, as measured by the F-statistics implies that there are major differences between cross-sectional and the pooled regressions, making the former more appropriate for any analysis. We are, thus, tempted, at first sight, to conclude that corporation tax does not exert any effect on the investment behaviour.

In analysing these results, however, it is important to insure that none of the assumptions underlying the regression techniques employed is violated. In particular, the low t-statistics of the tax variables may be due to the fact that this variable is correlated with another one in the model. If this is the case, then the estimated regression coefficients will tend to have larger standard errors than they would have in the absence of multicollinearity. This, in turn, implies that the t-ratios are smaller and that a particular variable that may appear to be insignificant could, if no multicollinearity was present, to be significant.

A correlation matrix between the variables included in the model is obtained for each year. It shows that the correlation between the inverse of the capital stock - which is the intercept of the equation -

and the tax variable is very high. For the pooled data, for instance, the coefficient of correlation ($\bar{R}^2$) between the inverse of the capital stock and the tax variable deflated by the lagged capital stock is 0.981, while for 1974 the Pearson correlation is 0.999. Similar results were obtained from other cross-sectionals, ranging from 0.90 to 0.999. The correlation is less pronounced for the other explanatory variables. The independent effects of each of these two correlated variables is, therefore, not captured properly in the above results.

The high multicollinearity between the change in the tax variable deflated by the capital stock and the inverse of the capital stock seems to be the direct result of the correction for the heteroscedasticity. Attempts have been made to try to obtain unbiased estimates. There is, however, no single preferable technique in econometrics for overcoming the problem of multicollinearity. One possible way of reducing the impact of multicollinearity between these variables is to extend the number of observations. However, due to the lack of data, this method cannot be used. Alternatively, the regression is run without the inverse of capital stock. The inverse of the capital stock is the constant of the original model before we corrected for the heteroscedasticity, i.e. β_5 in equation (6.1.6). By doing this, we constrain the original investment equation to go through the origin, i.e. $\beta_5 = 0$ in equation (6.1.6). However, previous studies have taken into account the constant in their estimated equation and in many cases it is significant. Therefore, the investment function without the inverse of capital stock could be mis-specified. The empirical results obtained from this specification show that in more than 80 per cent of the cases the tax variable is uncorrectly signed and highly significant.

Therefore, tax effects on investment cannot be directly analysed through the neoclassical model.

To test for a possible impact of tax exhaustion on investment behaviour, tax exhaustion variables are incorporated into the accelerator model. The accelerator model is preferred to the neoclassical model for this analysis, because including the tax exhaustion dummies in the neoclassical model may lead to a mis-specification of the model. Moreover, the effect of tax exhaustion is already included in the user cost of capital. Therefore, the inclusion of the tax exhaustion variables in the above specification may lead to double counting of the impact of taxation. In the following tables, the results obtained from the accelerator model which defines investment expenditure in terms of changes in the levels of output are reported.

TABLE 6.5. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_{i,t}}{K_{i,t-1}} = \gamma_0 + \gamma_1 HT_{i,t} + \gamma_2 TAX_{i,t} + \gamma_3 \Delta \frac{Q_{i,t,t-1}}{K_{i,t-1}} + \gamma_4 \frac{1}{K_{i,t-1}}$$

YEARS	COEFFICIENTS γ_0	γ_1	γ_2	γ_3	γ_4	σ_u σ_r	$F_{5,66}$
1973	0.122*	0.00	-0.199	0.0087	812*	0.381	45.210**
	(2.53)	(0.00)	(-1.85)	(0.96)	(32.2)	0.804	
1974	0.176*	-0.105	0.045	0.012	323*	0.265	1.802
	(5.20)	(-1.62)	(0.78)	(1.42)	(5.36)	0.283	
1975	0.085*	-0.053	0.060	0.002	540*	0.196	3.495**
	(3.08)	(-1.04)	(1.14)	(0.28)	(7.94)	0.221	
1976	0.078*	0.042	-0.030	0.005	363*	0.109	3.923**
	(5.28)	(1.47)	(-1.26)	(1.14)	(11.78)	0.125	
1977	0.013*	0.013	-0.008	-0.001	200*	0.118	6.902**
	(7.38)	(0.46)	(-0.02)	(-0.18)	(5.98)	0.156	
1978	0.113*	0.060*	-0.065*	0.023*	289*	0.117	17.364**
	(7.43)	(2.46)	(-2.49)	(9.32)	(19.35)	0.178	
1979	0.185*	0.028	-0.020	-0.020	446*	0.461	0.867
	(2.93)	(0.47)	(-0.20)	(-1.78)	(4.66)	0.476	
1980	0.164*	0.041	0.029	-0.005	210*	0.155	28.904**
	(7.84)	(1.32)	(0.73)	(-1.02)	(10.09)	0.277	
1981	0.154*	-0.007	-0.004	0.0009	140*	0.154	44.995**
	(7.88)	(-0.204)	(-0.14)	(0.193)	(8.44)	0.323	
1982	0.170*	-0.006	-0.058	0.0012	221*	0.313	4.839**
	(4.24)	(-0.13)	(-0.92)	(0.127)	(6.74)	0.366	
1983	0.194*	0.158*	-0.260*	0.009*	241*	0.201	13.219**
	(7.13)	(3.07)	(-5.03)	(1.995)	(10.31)	0.284	
POOLED	0.975*	0.019	-0.037*	0.033*	437*		
	(6.62)	(1.026)	(-2.17)	(16.37)	(26.76)		

Notes: Trace Matrix for pooled is 696.2 and for cross-sectional is 739.4;
t-statistics in brackets. * significant at 5% level. t_c = 1.960;
** significance at 5% level. critical value is 2.370;
Number of observations: 71 for cross-sectional and 781 for pooled.

TABLE 6.6. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_{i,t}}{K_{i,t-1}} = \gamma_0 + \gamma_1 HT_{i,t} + \gamma_2 TAX_{i,t} + \gamma_3 \Delta \frac{Q_{i,t,t-1}}{K_{i,t-1}} + \gamma_4 \frac{1}{K_{i,t-1}}$$

YEARS	COEFFICIENTS γ_0	γ_1	γ_2	γ_3	γ_4	$\bar{R}^2$	σ
1973	0.109*	0.00	-0.133	0.011	814*	0.951	0.394
	(2.12)	(0.00)	(-0.98)	(0.95)	(24.42)		
1974	0.177*	-0.137	0.080	0.0196	351*	0.266	0.274
	(4.73)	(-1.19)	(0.78)	(1.32)	(3.70)		
1975	0.069*	-0.003	0.008	-0.013	564*	0.410	0.200
	(2.23)	(-0.03)	(0.095)	(-1.11)	(6.94)		
1976	0.084*	0.017	-0.026	0.002	338*	0.615	0.113
	(5.01)	(0.36)	(-0.63)	(0.26)	(7.91)		
1977	0.121*	0.012	0.035	0.0014	202*	0.543	0.121
	(6.17)	(0.29)	(0.73)	(0.18)	(4.38)		
1978	0.109*	0.051	-0.050	0.029*	281*	0.789	0.118
	(6.43)	(1.27)	(-1.13)	(7.21)	(15.31)		
1979	0.161*	0.036	0.108	0.002	486*	0.109	0.474
	(2.08)	(0.259)	(0.46)	(0.074)	(3.42)		
1980	0.163*	0.070	0.023	-0.009	190*	0.464	0.159
	(6.93)	(1.46)	(0.37)	(-1.18)	(7.22)		
1981	0.163*	-0.020	-0.013	-0.003	120*	0.448	0.158
	(7.26)	(-0.28)	(-0.23)	(-0.28)	(4.46)		
1982	0.192*	-0.050	-0.027	0.018	193*	0.155	0.322
	(4.04)	(-0.38)	(-0.16)	(0.74)	(4.00)		
1983	0.215*	0.112	-0.279*	0.010	214*	0.475	0.206
	(6.89)	(1.31)	(-3.15)	(1.41)	(7.34)		
POOLED	0.105*	-0.0009	-0.046	0.051*	492*	0.658	0.356
	(7.06)	(-0.02)	(-1.13)	(14.27)	(36.55)		
(1)	0.099*	-	-	0.051*	491*	0.658	0.356
	(7.30)			(14.37)	(36.57)		
(2)	0.105*	-	-0.046	0.051*	492*	0.658	0.356
	(7.29)		(-1.25)	(14.28)	(36.60)		
1973-78	0.076*	-0.036	-0.007	0.049*	637*	0.827	0.293
	(5.15)	(-0.86)	(-0.19)	(14.72)	(46.32)		
1979-83	0.188*	0.062	-0.076	0.009	193	0.201	0.285
	(11.37)	(1.58)	(-1.58)	(1.88)	(10.33)		

Notes: t-statistics in brackets;
* significance at 5% level, $t_c = 1.960$;
$\bar{R}^2$ = coefficient of determination adjusted for d.f.;
σ = standard error of the regression;
Number of Observations 71 for cross-sectional and 781 for pooled.

The impact of tax exhaustion is not found to exert any strong impact on investment expenditure. Similar results were obtained when only one variable of tax exhaustion is included. Moreover, this insignificance does not seem to change over time as there are only two exceptional years in which tax exhaustion is significant and correctly signed when the seemingly unrelated regressions technique is employed. Even when the sample period is divided into two sub-periods, 1973-78 and 1979-83, the results are very similar. Indeed, when only these two dummies are used as independent variables, there was no significance at all. Therefore, firms do not seem to take account of their tax position in deciding on whether to undertake a particular project or not.

The econometric problems faced with in this analysis may prevent us from relating directly the results obtained here to those obtained by studies that used interviews and/or postal surveys to find that many companies do not seem to consider tax in their project appraisal (Levis and Morgan 1985, Hodgkinson 1987).

5. Conclusion :

An attempt has been made in this chapter to analyse the impact of taxation on investment behaviour using the neoclassical model. A number of empirical tests have been carried out in order to try to relate the tax position of the firm and the capital allowances to the investment decision. The original neoclassical model was first tested. The coefficient of the change in the optimal capital stock, through which tax effect may be analysed, is of the wrong sign in many cases and its degree of significance is substantially low. Therefore, on the basis of the assumptions underlying the neoclassical model, we can say that taxation does not exert any impact on investment decisions of the firm.

The original neoclassical model did not provide satisfactory opportunity to allow any impact of taxation to be assessed. In order to overcome this problem, the desired capital stock is split into its different components by assuming than the optimal capital stock can be approximated by additive, rather than multiplicative, combination of the relative components. This specification also indicated that taxation does not seem to exert any impact on the investment decisions of the firm. However, the spurious high multicollinearity between the tax variable and the inverse of the capital stock inhibits one to draw any sound conclusions on the impact of taxation on investment behaviour using this model.

An alternative way of testing for the impact of taxation on investment expenditure is to take the view that tax exhaustion may refrain firms from undertaking some projects, because they may not be able to claim the capital allowances. Using the accelerator model with a combination of tax exhaustion variables, we find that companies do not seem to consider tax in their investment decisions, thus joining the results obtained from previous specifications.

It is unfortunate to conclude this chapter by saying that the tax impact on investment cannot be properly analysed through the transformed neoclassical model. Consequently, the call for further more research on this topic cannot be avoided. This may generate some suspicions as to the worth of all the efforts spent to estimate the complex components of the desired capital stock. However, giving up the idea that the impact of taxation cannot be estimated using the neoclassical equation is not a step to be taken lightly as it is obviously open to the charge that it is only the structure of the data that does not allow us to draw strong conclusions on the coefficient of the tax variable.

It is also important to bear in mind that the investment decision is very crucial to the survival of the firm. Therefore, one would not expect this kind of decision to be solely determined by the variables included in the neoclassical model, or in the accelerator model (which is used here to analyse the impact of tax exhaustion). Financing and dividend decisions together with market valuation may also play an important role in determining investment programmes. External factors, such as uncertainty in the markets, may discourage the firm from investing. These elements are not included directly in the specifications tested in this chapter.

In interpreting the results obtained above, attention is drawn to the fact that capital is assumed to be homogeneous and that firms were considered to invest in only the industry they are in. If the homogeneity of capital stock assumption is relaxed, then it may be possible to construct the neoclassical model for each type of assets and to use appropriate tax variables, price index, depreciation rates and possibly the corresponding cost of capital accordingly. It may, therefore, be possible to determine the impact of taxation on each type of investment expenditure.

CHAPTER VII

EFFECTS OF TAXATION ON INVESTMENT: VALUATION MODEL

From the review of the literature we find that there are two main econometric models that can be used to analyse the impact of taxation on investment behaviour. Both these models are found to lead to the same results when applied to the aggregate data. However, it is necessary to test this model at individual company level because while the neoclassical model tests for the changes in the tax variable, the valuation ratio relates investment to the levels of the combination of the tax variable and the valuation ratio. Markets are assumed to be efficient and that investment rate is directly related to the ratio of the market value of the firm to its existing capital stock.

In this chapter we present empirical estimation of the 'Q' investment model. The first section is concerned with the hypotheses tested through the model. In the second section, variables used are defined. The third section deals with the data construction. The methodology followed in using this model at disaggregated level level is described in section four. Section five reports investment equations estimated under different assumptions as to the definition of the variables and the econometric specification, and provides some possible explanations for the results obtained. The concluding section summarises the findings and discusses ways of dealing with taxation on corporations.

1. Hypotheses Tested :

Previous empirical studies which used the valuation ratio support the hypothesis that taxation exerts strong impact on the level of investment expenditure. However, since they have used aggregate data, they assumed that all firms pay profit tax at the standard rate[1]. This is not the case, as we explained in chapter 1. It is, thus, necessary to use this model to analyse the different ways in which taxation may influence the level of investment of each company.

The formulation of the tax adjusted 'Q', as derived in chapter 5, contains not only the market capitalisation of the firm, but also the level of debt equity ratio, the present value of capital allowances and the effective corporation tax. The model is set in such a way as the following hypotheses may be tested :

(1) Investment rate is positively related to the level of the valuation ratio, for each company and for each year in the sample period;

(2) If hypothesis (1) is verified, then the following hypothesis may be valid :

(a) the level of investment expenditure may be increased by rising the market value of the firm;

(b) The firm's capital investment may be increased through a rise in the present value of capital allowances, or a decrease in the effective corporation tax rate;

(c) Investment is positively related to the level of debt-capital ratio, and therefore, any variables that may prevent the firm from increasing its gearing ratio affect indirectly the level of investment;

(3) If taxation does have a significant impact on investment

1. Poterba and Summers (1983) constrained the tax variables to be zero, i.e $\tau=A=B=0$, for the post-1972 period, to account for tax exhausted companies. They found that the explanatory power of the equation is reduced.

expenditure then we would expect the investment behaviour to be much better explained by the tax adjusted Q rather that by Tobin q.

In order to test these hypotheses, the following investment equation is formulated :

$$\frac{I_i}{K_{i_{t-1}}} = \alpha + \beta_1 \frac{1}{K_{i_{t-1}}} + \beta_2 Q_i \qquad (7.1.1)$$

2. Definition of the Variables :

Investment expenditure is defined as the total additions to property and other tangible assets at current prices. Investment is assumed to be undertaken evenly during the accounting year. At the end of the year, it is necessary to compute the level of investment on the same basis, i.e. taking into account the level of inflation that prevailed during the period.

There are two main explanatory variables. First, the investment decision of the firm is assumed to be based on the existing level of capital stock. The higher the total fixed assets at the beginning of the period, the more likely the firm will have to increase its gross investment to account for the depreciation.

Second, investment is assumed to be a function of a combination of the market value of the firm, investment incentives, debt capital ratio and the effective corporation tax, i.e.,

$$Q_{i_t} = \frac{\left[\dfrac{V_{i_t} - B_{i_t}}{p_{i_t} K_{i_{t-1}}} - 1 + A_{i_t} + b_{i_t}\right]}{1 - \tau_{i_t}} \qquad (7.2.1)$$

The higher the market value of the firm i at time t ($V_{i,t}$) relative to the existing level of capital stock ($K_{i,t-1}$) the more investment is undertaken. Tobin 'q' theory asserts that, if this ratio is higher than unity then, the market is willing to pay more for the existing level of capital stock of the firm. However, when taxation is introduced, this ratio need not be unity because of the capital allowances, the firm is able to deduct from its future cash flows and set against tax. To make the market value homogeneous in the level of existing capital stock, the present value of capital allowances on past investment expenditure are deducted. However, as far as this study is concerned, during the sample period, firms were assumed to claim during the first year the initial allowance of 100 per cent. Furthermore, there are less than 10 per cent of the total number of observations for which additions to assets are lower than disposals. Therefore, the pooled of remaining depreciation allowances is zero. Thus B_{i_t} is assumed to be zero.

As formulated in equation (7.2.1), the tax adjusted Q is a function of the the level of debt capital-ratio of the firm and of the tax variables. This ratio increases with a rise in the present value of allowances and decreases with an increase in the tax rate. Therefore, if the tax adjusted Q is positively correlated to the investment rate, then an increase in the present value of allowances would directly result in a rise in the investment expenditure, assuming everything being equal.

3. Methodology :

The above hypotheses are tested on pooled and cross-sectional data. The aim is, first, to find the impact of taxation on investment behaviour without taking time effect into account and, second, to analyse this impact for each individual year for a sample of companies. In this sense, it is possible to find the long-run relationship between investment, "Q", tax variables and other likely determinants of investment behaviour. Time series estimates are not obtained because of the relatively small sample period for each firm.

Previous empirical studies which used Tobin 'q' model of investment have concentrated on time series data at the aggregate. There are two main problems with these specifications. First, time series estimates would only provide with the short term effects of taxation. This would depend critically on the sample period of the analysis. The impact of taxation may only be analysed if there is a major change in the system during the sample period. Secondly, aggregation problems of the variables and of the relationship between the dependent and the explanatory variables has been the major difficulty of previous empirical studies. The main disadvantages of aggregating data are discussed in the estimation of the neoclassical model. There are, however, some specific problems of aggregation when the valuation model is used.

Oulton (1981) considered the issue that aggregate investment equations do not take into account the fact that most investment is irreversible. At the micro level investment function treats influences tending to cause an increase in investment expenditure asymmetrically from influences tending to cause a fall, because once investment is placed, it cannot be sold easily in the second hand market place. The market value of individual company is also affected by many special factors, which may be considered as multiplicative random shocks. Therefore, firm's "q" ratio is log normally distributed around the average level of "q". When Oulton corrected for these facts, using aggregate data, the results obtained were disappointing.

This study attempts to overcome some of these problems by looking at the investment behaviour of individual company. Similarly to the previous empirical chapters, two econometric specifications are used for both pooled and cross-sectional data. The coefficients obtained from the ordinarily least squares technique may be biased if the error term of one linear equation is correlated with that of another regression model. In order to correct for this possible error in the disturbance term, the seemingly unrelated regressions technique (SUR) is also performed for the pooled and cross-sectional data. Other assumptions of the OLS are also tested accordingly. Both results are presented for comparison and for analysis. The Chow test, as defined by equation (6.2.1), is used to test for the time effect when cross-sectional regressions are performed.

Another problem that may bias the significance of the coefficients obtained from the regressions is the likely existence of heteroskedasticity, which results from the fact that companies in the sample are not all of the same size. However, this model, as opposed to the neoclassical equation, specifies all the the variables in ratio terms, thus correcting for any possible heteroskedasticity bias.

4. Data construction :

The main data requirements for the estimation of the "Q" model are time series and cross-sectional values for the tax adjusted "Q", gross investment rate and capital stock at replacement cost. This section describes the construction of an annual time series for these variables for a sample of 109 non financial domestic companies for the period

1973-1983.

4.1 Gross investment rate :

The dependent variable in the estimated equation is the ratio of gross investment in property and other tangible assets to the net capital stock. Data on book value of additions to fixed assets is extracted from EXTAT data bank[2]. However, to find the relationship between these additions to existing assets and the level of the valuation ratio, it is necessary to convert the book values into replacement costs. This stems from the fact that investment could have been undertaken in the beginning of the period, and by the end of the accounting period prices may have increased and also that the level of capital stock at historical costs may not have any relation to its replacement value. It is assumed, for the additions to plant and machinery, that investment is taken evenly during the accounting period. In order to correct for these inflationary effects, firms in the sample are classified into different industries according to their SIC number and then *Price Indices for Current Cost Accounting*[3] are applied. These are, however, based on plant rather than firm. Thus, by using them for each firm, it is assumed that all the assets in the firm are related to the industry in which it is classified. The latter assumption may not distort the results because of the high correlation between the price indices of each industry. Another adjustment relates to the fact that not all companies report their accounts at the same time. Firms in

2. In EXTAT data bank *additions to property* (CC3) are published separately from *additions to other tangible assets* (CC11).

3. The necessary data is provided, as explained in the previous chapter, by Central Statistical Office (1982) and Business Monitor (1986).

the sample are divided into groups according to the quarter in which they publish their accounts. The corresponding price index is then applied.

Capital stock at replacement cost is computed in the same way as in the previous chapter. The reported current cost value for assets is the basis for pre- and post-1980 levels of capital stock. ICA (1982) found that current professional valuation is the means most frequently adopted to value property and that more than 80 per cent of companies surveyed revalue their property. On the other hand, indices to book values is the means almost universally adopted for plant and machinery. The computation of the capital stock, here, is based on these results. Given that there is no price index for property, *Property reevaluation* and *reevaluation of depreciation of property* are distributed evenly over the period. The sum of the former and the *additions to property* result in investment in property at current prices, while the sum of the latter and the *depreciation charge* is taken as the total depreciation used to compute depreciation rate. Investment in other tangible assets, on the other hand, is computed using the corresponding price index for current cost accounting. After calculating the depreciation rate, δ, as the ratio of depreciation charge over the capital stock, the following formula is used to compute the capital stock at current prices for firm i at time t :

$$K_{i_t} = I_{i_t} + (1-\delta_{i_t})K_{i_{t-1}}$$

4.2 Tax adjusted Q :

The principal data required to compute this variable are the market value of each firm in the sample from 1973 through to 1983. The main problem in relating the market value of the firm to its investment decision is that the former fluctuates significantly over a short period, while, investment plans, on the other hand, are usually fixed. In order to overcome this problem, the market price of ordinary shares are taken as the average of the highest and lowest prices during the calendar year, rather than the share prices at the time when the company reports its accounts. Multiplying this mean by the number of shares, adjusted from script and right issues, the average market value of the firm is obtained. Data is obtained from Extel Cards[4]. Data on the market value of preference shares is unavailable for all companies. When book values were included, the results did not change significantly, because of the low level proportion of preference shares in relation to capital stock[5]. The present value of outstanding writing down allowances are, as mentioned above, equal to zero because of the assumptions in the computation of the effective corporation tax rates.

The value of capital stock at replacement cost is computed as above. However, it is also necessary to take into consideration the value of stock and work in progress, (SWIP). These may be treated in two different ways : either as liquid assets, in which case their value is added to the market value of the firm, or as physical assets, thus adding them to the capital stock. Results obtained under both

4. The average for the accounting year, rather than for the calendar year, would have been used if data was available.

5. In relation to the book value of ordinary shares, preference shares, on average represent less than 5% for the companies in the sample. On market value basis and for all the industrial and commercial companies, this proportion is less than 0.001% (Bank of England data, or Poterba and Summers (1983) p. 165).

alternatives are very similar. The latter specification is reported here. To compute the replacement cost of stock and work in progress, it is assumed that all firms use the FIFO method of valuation of stocks (see ICA (1982)). To determine the last date of the purchase of the existing stock, a stock turnover ratio is computed. The SWIP at replacement cost is computed by multiplying the book values by the average increase in price index during the holding period (i.e. turnover ratio). If, for instance, the turnover ratio is two months and the firm reports its accounts in march, then the ratio of the price index in march to that in january reflects the rise in inflation in stocks. The monthly price indices are provided by the Central Statistical Office (1982), Business Monitor (1986) for each industry. These indices are produced to compute the stock relief, thus no data was available before 1974. Instead the Wholesale Price Index is used for 1973.

The debt capital ratios are computed in chapter 3[6], and the present value of capital allowances and the effective corporation tax rates are as calculated in chapter 5 and 2 respectively.

The following graphs show the average trends in the investment rate, Tobin "q" and the tax adjusted "Q".

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6. Poterba and Summers (1983) computed this variable as the ratio of long term debts to capital stock. This specification did not, however, change the results when tried here.

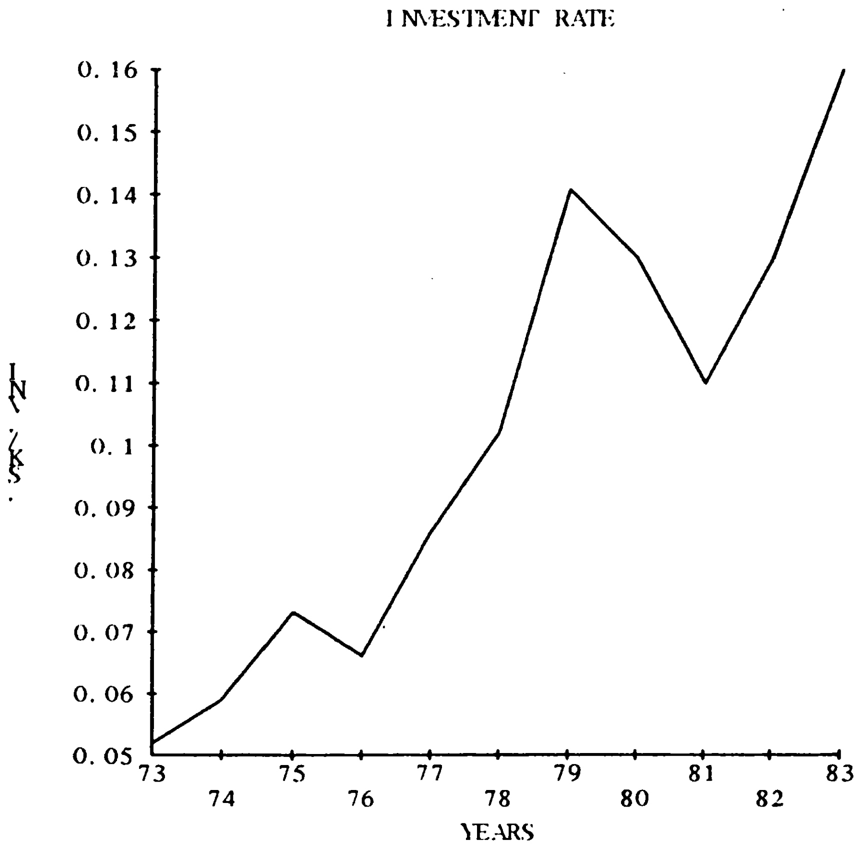

Figure 7.1. Investment rate

Notes : ________ Investment rate = additions to fixed assets over capital stock at replacement cost.

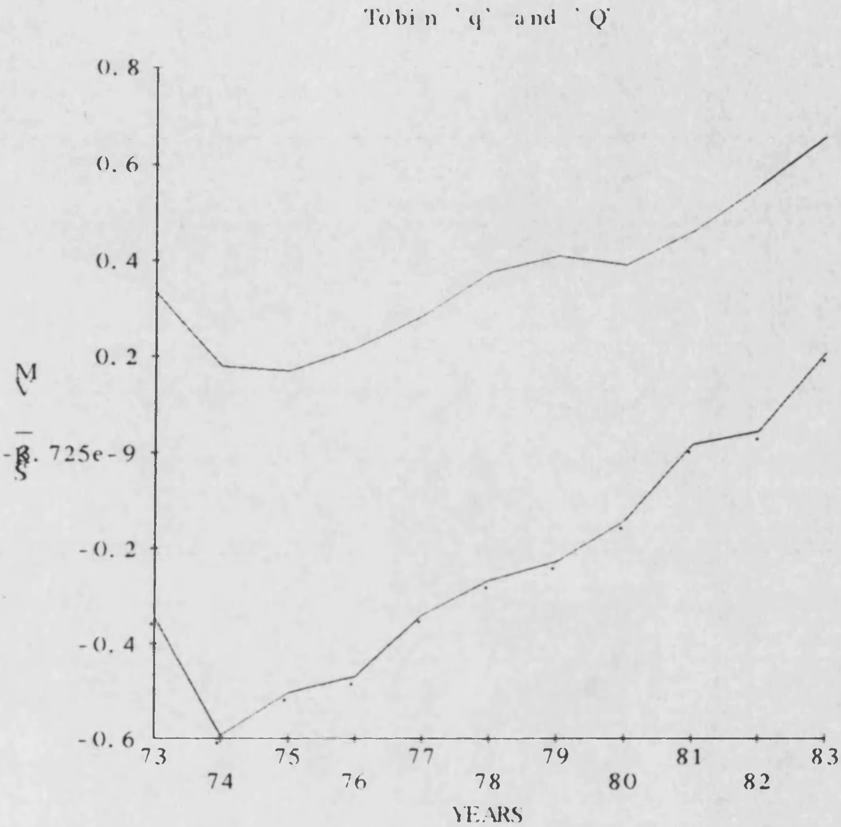

Figure 7.2. Tax adjusted 'Q' vs. Tobin 'q'

Notes : _._._ Tax adjusted "Q" as computed from equation (7.2.1);
________ Tobin 'q', market value of shares over capital stock at replacement cost.

From the above two graph, one can see the relatively similar movements in investment rate and the valuation ratio. The low levels in early seventies are due to a combination of the sharp decline in the market values. Poterba and Summers (1983), using all industrial and commercial companies, found, for instance, tax adjusted "Q" of -0.213 and "q" of 0.11 in 1975. The low level of debts, as seen in chapter 3, has also contributed to the negative values of this ratio. However, the most important factor that lead to the decline of the valuation ratio in the 1970s is the corporation tax. Comparing the tax adjusted "Q" and Tobin 'q' we can see that a substantial gap is created by the low allowances claimed by companies.

5. Empirical results :

Equation (7.1.1) is estimated using both cross-sectional and pooled data. Since the seemingly unrelated regressions techniques performs the regressions in a set of all equations (i.e. 11), the number of observations has to be restricted to be the same for each cross-sectional. Therefore, instead of including all the 109 firms in the sample we could only have 67 firms for each year, resulting in 737 observations for the pooled regressions.

TABLE 7.1. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 \frac{1}{K_{i,-1}} + \beta_2 Q_i$$

YEARS	COEFFICIENTS				
	α	β_1	β_2	σ_u σ_r	$F_{3,64}$
1973	0.034*	211*	0.022*	0.032	10.69**
	(6.23)	(6.55)	(3.43)	0.040	
1974	0.060*	286*	0.051*	0.040	5.00**
	(4.91)	(5.12)	(3.17)	0.044	
1975	0.053*	219*	0.034*	0.039	3.17**
	(6.45)	(4.54)	(3.17)	0.041	
1976	0.049*	114*	0.028*	0.028	12.08**
	(7.67)	(2.61)	(3.18)	0.036	
1977	0.065*	168*	0.033*	0.043	0.70
	(7.32)	(3.17)	(2.43)	0.044	
1978	0.071*	242*	0.036*	0.043	2.69**
	(9.44)	(6.01)	(3.21)	0.046	
1979	0.082*	322*	0.032	0.082	3.13**
	(6.44)	(4.60)	(1.78)	0.088	
1980	0.072*	409*	-0.014	0.080	6.35**
	(5.67)	(5.59)	(-1.07)	0.091	
1981	0.070*	192*	0.012	0.054	2.20
	(8.55)	(4.27)	(1.34)	0.057	
1982	0.075*	261*	0.0008	0.072	3.19**
	(7.08)	(4.63)	(0.087)	0.077	
1983	0.094*	333*	0.019	0.110	4.91**
	(6.06)	(4.56)	(1.49)	0.122	
POOLED	0.053*	246*	0.018*		
	(12.46)	(10.62)	(4.74)		

Notes : t-statistics in brackets;

* Significant at 5% level; t_c = 1.960;

** Significant at 5% level; F_c = 2.329;

Trace matrix of cross-sectional is 711 and 716 for pooled;

σ_u σ_r = standard error of the estimates for cross-sectional and pooled;

Number of observations = 67 for cross-sectional and 737 for pooled.

TABLE 7.2. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 \frac{1}{K_{i,-1}} + \beta_2 Q_i$$

YEARS	COEFFICIENTS α	β_1	β_2	$\bar{R}^2$	σ
1973	0.036*	217*	0.029*	0.518	0.033
	(5.98)	(5.74)	(3.84)		
1974	0.093*	234*	0.101*	0.463	0.039
	(6.44)	(3.59)	(5.19)		
1975	0.069*	226*	0.067*	0.326	0.038
	(6.53)	(3.49)	(4.32)		
1976	0.061*	62.04	0.046*	0.211	0.028
	(8.03)	(1.19)	(4.09)		
1977	0.064*	147*	0.027	0.086	0.044
	(6.14)	(2.25)	(1.51)		
1978	0.078*	188*	0.040*	0.275	0.044
	(8.77)	(3.74)	(2.56)		
1979	0.096*	191*	0.043	0.083	0.083
	(6.41)	(2.06)	(1.59)		
1980	0.080*	331*	-0.016	0.172	0.081
	(5.59)	(3.71)	(-0.9)		
1981	0.075*	144*	0.017	0.174	0.055
	(8.66)	(2.85)	(1.56)		
1982	0.080*	217*	0.001	0.165	0.073
	(7.17)	(3.45)	(0.12)		
1983	0.098*	304*	0.018	0.200	0.112
	(5.99)	(3.71)	(1.06)		
POOLED	0.075*	156*	0.042*	0.212	0.073
	(24.35)	(9.51)	(11.37)		
1973-78	0.072*	140*	0.060*	0.248	0.057
	(17.62)	(6.54)	(10.53)		
1979-83	0.091*	152*	0.024*	0.136	0.085
	(17.99)	(6.31)	(4.55)		

Notes : t-statistics in brackets;

* significant at 5% level, t_c =1.960.

$\bar{R}^2$ coefficient of determination adjusted for degrees of freedom.

σ standard error of the estimates.

Number of observations = 67 for cross-sectional and 737 for pooled.

The results reported in Table 7.1 and Table 7.2 do support the "Q" model of investment for the earlier years of the sample period. Although the coefficient of the tax adjusted Q is nearly always of the expected sign, the significance seems to drop after 1979. This is also reflected in the pooled when the sample is divided into two sub-periods. The t-statistics of the coefficient of Q for 1973-78 period is much higher than that of 1979-83[7].

These relatively poor results during the second sub-period are probably due to the reform in personal income taxation during 1979 (as explained in chapter 4). The results obtained from pooled cross-sectional time series data point to a strong influence of the tax adjusted Q on investment behaviour. They are, thus, similar to these obtained by Poterba (1982), Poterba and Summers (1983, 1985) and Summers (1981) using aggregate data, although these studies have obtained only time series estimates. The aggregate results, however, show a relatively strong responsiveness of investment to 'Q', as measured by $\bar{R}^2$, than those found in this study. This is probably due to the fact that aggregation may reduce some of the noise of individual firm's 'Q'. However, the highly significant Chow test implies that there are major differences between cross-sectional and pooled regressions. Therefore, the cross-sectional results are more appropriate for our analysis. Direct conclusion cannot be drawn from

7. These results are in line with these obtained when this model is applied to the aggregate industrial and commercial companies. We found that the coefficient of Q drops from highly significant for the 1967-78 period to nearly insignificance for 1979-84.

cross-sectional results as to the significance of the tax adjusted Q because, in nearly half the sample period the coefficient of Q is not significant. Moreover, the low $\bar{R}^2$ values indicate that much of what affects investment behaviour is not captured by the explanatory variables used in this model. Salinger and Summers (1983) estimated the 'Q' equation for each of the thirty Dow Jones companies. They obtained time series estimates for each company. The $\bar{R}^2$ obtained has fluctuated from as low as 0.01 to 0.79 and the tax adjusted Q is only significant in about 50 per cent of the cases.

In order to measure the importance of tax adjustments in the valuation model, Salinger and Summers (1983) contrasted the relative explanatory power of Tobin q and the tax adjusted Q by using both of them in the same regression. They argued that, if investment rate is determined by the tax adjusted 'Q', then we would expect the coefficient of Q to be significant and positive while that of q to be insignificant. The reason being that, since the market is very volatile and capital is not homogeneous, then the stock market element of q is expected to be a very noisy signal of the marginal return on incremental investment. On the other hand, the tax adjustment components of the Q series are much less subject to error. Therefore, their effect may be expected to be greater than that of the stock market. Because of this, the coefficient of q may be negative. The tax adjusted Q was found to be positive and significant in most of the cases, while q is negative and insignificant. It is therefore important to make adjustments for tax when studying the relationship between investment and q.

The relative explanatory power of the tax adjusted 'Q' and the Tobin 'q' are contrasted and the results obtained using the ordinarily least squares and the seemingly unrelated regressions technique are reported in the following tables.

TABLE 7..3. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 q_i + \beta_2 Q_i$$

YEARS	COEFFICIENTS				
	α	β_1	β_2	σ_u σ_r	$F_{3,64}$
1973	0.056*	-0.002	0.037*	0.040	7.68**
	(7.56)	(-0.15)	(5.24).	0.046	
1974	0.095*	-0.001	0.068*	0.044	5.36**
	(7.81)	(-0.72)	(4.19)	0.049	
1975	0.085*	-0.003*	0.044*	0.041	3.76**
	(9.25)	(-2.51)	(4.01)	0.044	
1976	0.062*	-0.001	0.028*	0.028	7.87**
	(9.22)	(-0.99)	(3.11)	0.033	
1977	0.082*	-0.0003	0.038*	0.045	0.05
	(8.86)	(-0.20)	(2.61)	0.045	
1978	0.094*	0.0013	0.051*	0.047	5.66**
	(11.13)	(1.07)	(4.36)	0.052	
1979	0.108*	0.001	0.042*	0.084	4.30**
	(7.86)	(0.54)	(2.37)	0.092	
1980	0.129*	-0.003	0.005	0.087	5.83**
	(7.24)	(-0.86)	(0.43)	0.098	
1981	0.080*	0.002	0.019*	0.056	2.65
	(7.87)	(1.41)	(2.29)	0.060	
1982	0.097*	0.001	0.010	0.078	2.94**
	(6.85)	(0.54)	(1.17)	0.083	
1983	0.175*	-0.103*	0.027*	0.113	7.95**
	(8.53)	(-3.17)	(2.12)	0.133	
POOLED	0.076*	-0.005	0.026*		
	(18.31)	(-1.23)	(6.38)		

Notes : t-statistics in brackets;

* Significant at 5% level; t_c = 1.960;

** Significant at 5% level; F_c =2.760;

Trace matrix: pooled = 700, cross-sectional = 711;

σ_u σ_r = standard error of the estimates for cross-sectional and pooled;

Number of observations = 67 for cross-sectional and 737 for pooled.

TABLE 7.4. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 q_i + \beta_2 Q_i$$

YEARS	COEFFICIENTS α	β_1	β_2	$\bar{R}^2$	σ	CORR
1973	0.063*	-0.002	0.044*	0.280	0.040	0.79
	(7.40)	(-0.94)	(5.05)			
1974	0.126*	-0.001	0.124*	0.356	0.042	0.64
	(8.50)	(-0.24)	(6.17)			
1975	0.103*	-0.003	0.073*	0.242	0.041	0.32
	(7.98)	(-1.93)	(4.42)			
1976	0.071*	-0.001	0.046*	0.207	0.028	0.52
	(8.91)	(-1.03)	(4.07)			
1977	0.081*	-0.0007	0.030	0.015	0.046	0.61
	(7.28)	(-0.34)	(1.66)			
1978	0.088*	0.003	0.051*	0.143	0.048	0.69
	(7.70)	(1.39)	(3.10)			
1979	0.113*	0.0005	0.052	0.022	0.086	0.69
	(5.84)	(0.14)	(1.87)			
1980	0.132*	-0.003	0.020	0.002	0.089	0.68
	(5.90)	(-0.72)	(1.23)			
1981	0.074*	0.004	0.028*	0.105	0.057	0.79
	(6.01)	(1.60)	(2.69)			
1982	0.093*	0.002	0.018	0.015	0.080	0.88
	(5.05)	(0.61)	(1.63)			
1983	0.192*	-0.140*	0.030	0.152	0.115	0.92
	(7.43)	(-3.08)	(1.75)			
POOLED	0.061*	0.064*	0.018*	0.169	0.075	0.82
	(9.98)	(5.84)	(2.81)			
1973-78	0.051*	0.083*	0.033*	0.244	0.057	0.68
	(7.42)	(6.32)	(4.19)			
1979-83	0.087*	0.041*	0.010	0.069	0.089	0.84
	(8.50)	(2.39)	(0.99)			

Notes : t-statistics in brackets;

* significant at 5% level, t_c =1.960;

$\bar{R}^2$ coefficient of determination adjusted for degrees of freedom;

σ standard error of the estimates;

CORR = Pearson product moment correlation between q and Q;

Number of observations = 67 for cross-sectional and 737 for pooled.

The results shown in Table 7.4 and Table 7.5 are in line with these obtained by Salinger and Summers for time series regressions. Nearly all the coefficients of q are negative and insignificant, while the coefficients of the tax adjusted Q are in all cases positive and, out of these 82 per cent are significant when the SUR method is used and 54 per cent using the ordinarily least squares. These results, therefore, could stress the importance of making tax adjustments in relating investment to the valuation ratio.

However, since Tobin q is a component of the tax adjusted Q, it is possible that the two variables are highly correlated. Salinger and Summers did not provide any test for multicollinearity. The Pearson product moment correlation between Tobin q and the tax adjusted Q is performed for the pooled and cross-sectional, the results of which are reported in the last column of Table 7.4. The relative difference between tax adjusted Q and Tobin q in their correlation coefficient is relatively low in 1975 and 1976 but it is quite high in the remaining years. It seems that the high multicollinearity is in the last three years of the sample period.

An alternative way of analysing the possible impact of taxation on investment through the tax adjusted Q is to find which of q or tax adjusted Q explains more the investment rate. The same regressions are performed by taking "q" rather than "Q" as an independent variable. The results, reported in Table 7.5 and Table 7.6, point to a slight superiority of the tax adjusted "Q" (as reported in Table 7.1 and 7.2). However, in general, the sign and the significance of Q and q is nearly the same in cross-sectional regressions. The insignificance of q is also concentrated in the post 1979 period.

TABLE 7.5. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: SUR

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 \frac{1}{K_{i,-1}} + \beta_2 q_i$$

YEARS	COEFFICIENTS				
	α	β_1	β_2	σ_u σ_r	$F_{3,64}$
1973	0.030*	229*	0.010*	0.034	8.16**
	(5.54)	(6.98)	(2.51)	0.040	
1974	0.053*	300*	0.037*	0.041	3.59**
	(4.55)	(5.40)	(2.71)	0.044	
1975	0.050*	227*	0.028*	0.039	2.64
	(6.60)	(4.81)	(3.29)	0.041	
1976	0.047*	123*	0.022*	0.029	11.22**
	(7.50)	(2.80)	(2.99)	0.036	
1977	0.064*	178*	0.031*	0.043	0.64
	(7.49)	(3.39)	(2.58)	0.044	
1978	0.071*	245*	0.034*	0.043	2.52
	(9.32)	(6.06)	(3.05)	0.046	
1979	0.083*	312*	0.033	0.082	3.15**
	(6.55)	(4.49)	(1.82)	0.088	
1980	0.071*	419*	-0.017	0.080	6.10**
	(5.55)	(5.79)	(-1.20)	0.090	
1981	0.070*	193*	0.011	0.054	2.17
	(8.57)	(4.32)	(1.31)	0.057	
1982	0.074*	268*	0.0001	0.072	2.91**
	(7.03)	(4.80)	(0.12)	0.077	
1983	0.093*	345*	0.02	0.110	4.87**
	(6.00)	(4.75)	(1.43)	0.122	
POOLED	0.053*	249*	0.017*		
	(12.24)	(10.67)	(5.16)		

Notes : t-statistics in brackets; * Significant at 5% level: t_c = 1.960;

** Significant at 5% level: F_c =2.76;

Trace matrix: pooled = 715, cross-sectional = 713;

σ_u σ_r = standard error of the estimates for cross-sectional and pooled;

Number of observations = 67 for cross-sectional and 737 for pooled.

TABLE 7.6. RESULTS OF POOLED AND CROSS-SECTIONAL INVESTMENT EQUATION: OLS

$$\frac{I_i}{K_{i,-1}} = \alpha + \beta_1 \frac{1}{K_{i,-1}} + \beta_2 q_i$$

YEARS	COEFFICIENTS				
	α	β_1	β_2	$\bar{R}^2$	σ
1973	0.032*	233*	0.014*	0.476	0.034
	(5.28)	(5.96)	(2.90)		
1974	0.086*	242*	0.081*	0.441	0.040
	(6.11)	(3.64)	(4.82)		
1975	0.064*	228*	0.052*	0.309	0.039
	(6.37)	(3.46)	(4.07)		
1976	0.058*	62.5	0.036*	0.188	0.029
	(7.84)	(1.18)	(3.80)		
1977	0.063*	153*	0.024	0.087	0.044
	(6.29)	(2.35)	(1.53)		
1978	0.077*	191*	0.037*	0.269	0.044
	(8.64)	(3.81)	(2.44)		
1979	0.095*	195*	0.041	0.078	0.083
	(6.34)	(2.10)	(1.49)		
1980	0.080*	333*	-0.018	0.174	0.081
	(5.55)	(3.76)	(-0.96)		
1981	0.075*	145*	0.017	0.174	0.055
	(8.66)	(2.88)	(1.56)		
1982	0.080*	217*	0.016	0.165	0.073
	(7.19)	(3.46)	(0.14)		
1983	0.098*	305*	0.019	0.200	0.112
	(5.99)	(3.72)	(1.06)		
POOLED	0.039*	132*	0.073*	0.211	0.073
	(11.19)	(7.80)	(11.29)		
1973-78	0.022*	95.8*	0.104*	0.245	0.057
	(5.96)	(4.22)	(10.39)		
1979-83	0.070*	142*	0.041*	0.133	0.086
	(10.40)	(5.75)	(4.36)		

Notes : t-statistics in brackets;

* significant at 5% level, t_c =1.960.

$\bar{R}^2$ coefficient of determination adjusted for degrees of freedom.

σ standard error of the estimates.

Number of observations = 67 for cross-sectional and 737 for pooled.

From the above results we may conclude that corporate taxation does not influence substantially the level of investment undertaken by the firm. If there was any significant difference between the results obtained from the first regressions (Table 7.1 and 7.2) and when investment rate is related to the Tobin q we could have concluded for an impact of taxation. However, the results obtained using the tax adjusted Q are not significantly affected by tax adjustment, because similar results are obtained without any adjustment. It may, however, be the case that these results are only due to the fact that many companies in the sample are tax exhausted, therefore, the ratio of allowances over the effective corporation tax rate is equal to one. However, figure 7.2 shows clearly that there is a significant difference between the two values. Therefore, we can only say that taxation does not exert any impact.

6. Conclusion :

This chapter has attempted to find some relationship between corporation tax and the rate of investment using the valuation model. Data is computed for each firm individually. As opposed to the neoclassical model of investment, the results obtained from this equation point to a strong influence of the valuation ratio on investment expenditure. However the relatively high explanatory power of this specification is found to be limited to the period before 1979. When the tax adjusted Q is contrasted with the Tobin q by using both these variables in the same equation the results supported strongly the tax adjusted Q, indicating, therefore, that tax has some impact on investment rate. However, the high multicollinearity between these two variables does not allow us to draw any consistent conclusions as to the possible impact of taxation. Instead, regressions were performed using Tobin q as an explanatory variable. The results obtained were very similar to the previous ones. In other words whether one recognises the tax effects or not, the results are still the same. It was, therefore, concluded that taxation does not exert any impact on investment decisions.

While these results provide some further evidence that companies do not seem to take account of their tax position in their investment behaviour, a great deal needs to be done before any generalisation may be made. The sample of firms may be increased to take account of international companies. These are likely to be larger than the domestic ones considered here, thus, as previous studies have found, may use more sophisticated methods of selecting their projects and may take account of their tax position in their investment decisions. Time series estimates may provide some information concerning the differences in the responsiveness of individual firm's investment to changes in the tax system. Further, the relaxation of the assumption of the homogeneity of capital may require a computation of "Q" for each class of assets, with their specific depreciation rate, price index, tax treatment and cost of capital.

CHAPTER VIII

CONCLUSION

The important question this thesis has attempted to address is whether taxation exerts any impact on the financing, dividend and investment decisions of the firm. There is no direct reason for taxing corporations as distinct from their owners. However, since taxation could distort the financial behaviour of the firms, it is worth analysing. The question of shifting corporation tax is left aside, and it is assumed, throughout this thesis, that the burden of taxation rests upon the owners of the firm.

The implications of many studies in the modern financial theory that taxation changes the behaviour of firms have resulted in an implementation of some fiscal policies designed to alter particular financing decision of the firm and/or to encourage capital formation. Managers, being rational, are expected to adapt to this policy in order to maximise their shareholders wealth. The models tested in this study are based on these assumptions and we have taken the view that capital markets are efficient so that, for instance, the investment rate could be related to the ratio of the market value of the firm to its existing capital stock.

These broad assumptions have lead us to assume that companies were able to forecast their tax position and to adjust their financial behaviour accordingly. Following the theory and under these assumptions we would expect company's financing decision to be based on its tax position. In particular, if it pays tax, then by having a low debt-capital ratio it incurs an opportunity cost equal to the tax shields which results from the deduction of interest payments from taxable profit. Furthermore, since the payment of dividends result in an increase in shareholders' personal income tax, a cut in dividends would result in the possibility of financing a particular project with a lower overall tax bill as, in this case, the company would not have to issue new shares. Furthermore, a firm is expected to respond positively to any increase in the tax allowances or to a decrease in the corporate tax rate because this would result in a lower cost of capital, by increasing its investment expenditure. The three financial decisions - financing, dividend and investment - are assumed to be inter-related and that any tax policy which aims at altering one of these decisions will have an indirect effect on the other two.

The bulk of the empirical work reported in this thesis is concerned with the various tests to determine the extent to which both personal and corporate taxation determine the financial policy of the firm. As has been argued, much of these tests are based on some macro-econometric models which assume that firms in the economy are homogeneous in their position towards taxation and in other explanatory variables. We argued that, at individual firm's level, these variables are specific situation characteristics of each individual company, and that, without violating any of the above assumptions, the behaviour of one company could be different from another. We have, first, analysed how and why our sample of companies is different from the aggregate data, as far as taxation is concerned, before considering the impact of taxation on the firms' financial policy.

Chapter 2 has discussed the main issues relating to taxing corporations. These relate to the controversy as to why companies are taxed differently from their owners, and to the inflationary impact on the tax base. The different ways of taxing corporations to eliminate some of these problems are presented, the underlying tax system for our analysis is described and the effective corporation tax rates for a sample of domestic companies are computed. It was found that the distortion of taxation is reduced by the fact that nominal interests are deducted from profits before tax, and that the tax system provides some allowances and reliefs to counter the impact of inflation. However, when these deductions are accounted for, business income taxation turns into a subsidy as a large number of companies had negative taxable profit during the sample period. The remaining chapters have used these results to test for the effects of taxation on the financing, dividend and investment decisions of the firms.

Chapter 3 presents an empirical evidence on the impact of taxation on debt-capital ratio. Firms in the sample were found to finance most of their investment project using either retained earnings or new issues of shares. This chapter has attempted to find the reasons why the *all debts* finance theory does not work in practice. The hypothesis that the desired level of debts is a function of bankruptcy risk and of the tax shields is tested. If the firm is not in a position to claim tax on interest, an increase in debts would only result in a rise in the premium for risk as required by shareholders and lenders. The empirical results support the view that a target debt-capital ratio is a function of the tax exhaustion position, required rate of return by shareholders and the level of interest rate. It appears from these results that, if a company is tax exhausted it cannot take advantage of the tax shields, and, as a consequence, it prefers to finance its investment projects using new issues or retained earnings. This conforms with the rational behaviour assumption.

The impact of taxation on dividend distribution has been the area of concentration of chapter 4. Leaving the difficulty of finding any plausible theoretical explanation of dividend behaviour aside, the analysis is carried out on the basis of Lintner's partial adjustment model which allows for tax discrimination between dividends and retained earnings. The main problem that was encountered in trying to apply this model at the individual firms' level was in measuring the marginal income tax rate of shareholders of each company. Because of the unavailability of detailed composition of the categories of shareholders and their relative tax brackets, the computation of the tax discrimination variable was done on the basis of a weighted average of the interests of directors, which were assumed to be in the highest tax bracket, and of the aggregate average income tax rate. The empirical results obtained using the pooled data are similar to those obtained on aggregate data in that they provide some evidence tax discrimination affects dividend policy. Moreover, firms appear to take account of their tax position in their dividend decision. Specifically, if the firm is not likely to recover the advanced corporation tax, it pays lower dividends. However, some further work is needed on this issue to isolate the impact of profitability. The cross-sectional results, on the other hand, do not appear to yield direct conclusions on such impact because of the major changes in the tax system during the sample period, but the coefficients of the tax variable do not seem to vary significantly from one period to another. Although the results are not found to be sensitive to alternative definitions of this tax discrimination variable, a more accurate calculation of θ is still needed to take account of all the different categories of shareholders for each individual company. This area together with a theory behind dividend distribution are clearly ways in which some further research could usefully be done.

The major theme that has initiated this research was the question of how investment may be encouraged through changes in taxation. The major macro-economics model, if they consider the impact of taxation, use aggregate data. Empirical evidence at company level is very rare despite the micro-economic origins of the investment models. The reason for using aggregate data is probably due to the difficulty in computing effective corporation tax and other specific variables for each company, while at the aggregate statutory rates are easily available. Chapter 5, thus, has dealt with the main issues that surrounded previous empirical studies on investment behaviour. It was necessary to review both sets of literature in order to pick up all the different variables that exert some influence on investment decision. These are defined and constructed in chapter 6 for the neoclassical model and in chapter 7 for the valuation model.

The results obtained from both these main econometric models lead to the conclusion that taxation does not appear to exert any influence on investment behaviour. The pooled cross-sectional time series regressions are also performed, but it was found that there are significant differences between the individual cross-sectional, thus, making the pooled results biased. The original neoclassical model did not provide consistent results as the coefficient of the change in the optimal capital stock is in most cases insignificant and with a wrong sign. Therefore, since this model assumes that the elasticity of investment with respect to the different components of the desired capital stock is equal to unity, we conclude that taxation does not affect the investment decision of the firm. When this assumption is relaxed, the coefficient of the tax variable is, in most cases not significant, although it is of the expected sign. However, the spurious multicollinearity between this variable and the inverse of capital stock may have biased these results. Nevertheless, tax exhaustion is found not to exert any impact on investment expenditure, therefore confirming the previous conclusions.

The valuation ratio has also refuted any impact of taxation on investment behaviour. The coefficient of the tax adjusted Q is found to be significant in only about 50 per cent of the cases. Similar results were obtained when the valuation ratio is defined without adjusting for taxation. However, econometric problems have prevented us from drawing any conclusion on the tax impact, when the relative performance of the tax adjusted Q is contrasted to that of the Tobin q.

The econometric results obtained in this research appear to imply that companies in the sample are different in their behaviour depending on the type of financial policy. Firms are found to consider their tax position in deciding on how to finance their project. Moreover, the pooled results imply that these companies are influenced by their tax position and their shareholders personal income taxation in deciding on their dividend policy. They seem to go up to the point where they want to 'buy back' dividends in order to reduce their shareholders personal income taxation. This behaviour supports our rational assumption, not in the sense that companies pay dividends, but rather on their behaviour towards tax. However, concluding, as implied by the results, that companies do not act at maximising their shareholders wealth by not responding positively to the tax incentives and that capital allowances are not an efficient instrument for encouraging capital formation, is not obviously a step to be taken lightly as our results are open to the charge that the lack of relationship between corporate investment and taxation may be due to the major econometric problems encountered. Consequently, it is hard to avoid ending this study without a call for further research on the topic. One possible way of reducing the impact of the problems created by the data is by concentrating the analysis on a more homogeneous sample of companies, or alternatively, obtain data for a longer sample period and analyse short-term effects of taxation.

In the above analysis the impact of leasing was not taken into account. Taxation could be important in the decision on whether to acquire or to lease the asset. If the company is in a tax exhaustion position then it may be more profitable to rent rather than to buy the equipment. The lessor, being in tax paying position will be able to claim investment allowances on the purchases of capital equipment and will be able to reduce the rental rate to the lessee who is tax exhausted. Leased equipment is not taken into account in this analysis because of the lack of data. This provides clearly a direction for further research.

The general limitations of the study are that the sample period has been characterised by very high rates of inflation and high interest rates. If time has not been the major constraint, the impact of each of the elements could have been analysed separately, in addition to the extent to which firms have invested in plant and machinery for purely fiscal reasons, the timing of investment, time series effects and other determinants, such as profitability. Nonetheless, the results of this research have provided a beginning for the study of this area.

As for the student, he has ended up with more questions than answers on the impact of taxation on the firms' behaviour and this has resulted in an eagerness for more research on the subject.

APPENDIX I : COMPUTATION OF COST OF CAPITAL

The cost of capital used in the neoclassical model is estimated using the Capital Asset Pricing Model (CAPM). In this appendix we present the differences in the estimation of this variable using three different methods. The first relates the returns on a security at time t to the return on the market at time t, i.e. without any lags or leads. This method has been criticised in the literature as being unable to account for the thin trading that may occur if a particular security has not been trading during this period. In order to correct for this possibility, Dimson (1979) argued that taking account of the leads and lags will give unbiased results. He suggested five leads and five corresponding lags, and the estimated beta will be the sum of all the eleven coefficients obtained from the regression. Alternatively, if the security has not been traded in the previous three months[1], then using the lagged market return for three previous months and obtaining beta as the sum of the four coefficients obtained may reduce this biase. In the following tables we compare the results obtained using these three methods in terms of their stability and also compute the cost of capital using these three different alternatives.

Since our results are based on the pooled cross-sectional time series data, and also the seemingly unrelated regressions technique takes account of the changes through different years, it is important to concentrate on the stability of the cost of capital in choosing the

1. A number of other lags have been tried but the specification with three lags appears to give more stable results.

estimation method. Companies selected for comparison are chosen in such a way as to include also small companies. We present the comparison of only five companies, but in the next table all the estimated betas and CAPM used are reported.

TABLE I.1. Cost of capital of Firm 1.

YEARS	β_1	β_2	β_3	$CAPM_1$	$CAPM_2$	$CAPM_3$
1972	1.5418	3.1282	2.0111	0.1355	0.1717	0.1462
1973	1.7671	3.1689	2.1965	0.1406	0.1726	0.1504
1974	1.7784	2.2396	1.5190	0.1409	0.1514	0.1350
1975	1.8072	2.2142	1.7442	0.1415	0.1508	0.1401
1976	1.8568	1.8868	1.6774	0.1427	0.1434	0.1386
1977	1.9421	1.5639	1.5879	0.1446	0.1360	0.1365
1978	2.0069	1.5411	1.6381	0.1461	0.1355	0.1377
1979	2.1258	1.9143	2.3484	0.1488	0.1440	0.1539
1980	2.2206	1.3461	1.6649	0.1510	0.1312	0.1383
1981	1.8630	0.4301	0.9187	0.1430	0.1101	0.1213
1982	1.6612	0.2585	0.7086	0.1382	0.1062	0.1165
1983	1.4911	-0.5098	0.3412	0.1343	0.0887	0.1081
Mean	1.8385	1.5980	1.5300	0.1422	0.1368	0.1352
σ	0.2171	1.1060	0.5960	0.0049	0.0252	0.0136

Notes: β_1 is obtained from $\tilde{R}_T = \alpha_T + \beta_T \tilde{R}_{mT} + \hat{v}_T$

β_2 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{11} \beta_{iT} \hat{R}_{mT_{t}\ 5i,i+5} + \tilde{v}_T$

β_3 is obtained from $\hat{R}_T = \alpha_T + \sum_{i=1}^{4} \beta_{iT} \hat{R}_{mT_{t}\ 3i} + \hat{v}_T$

$CAPM_1 = 0.1003 + \beta_1{*}(0.12312-0.1003)$

$CAPM_2 = 0.1003 + \beta_2{*}(0.12312-0.1003)$

$CAPM_3 = 0.1003 + \beta_3{*}(0.12312-0.1003)$

Where T is the interval length = 60 months;

$\hat{R}_T$ is the observed return in period T of this firm;

$\tilde{R}_{mT}$ = observed return on 750 actuaries ordinary share index;

$\tilde{v}_t$ is the stochastic disturbance term.

TABLE 12. Cost of Capital Firm 2.

YEARS	β_1	β_2	β_3	$CAPM_1$	$CAPM_2$	$CAPM_3$
1972	0.8494	0.5942	0.4600	0.1197	0.1139	0.1108
1973	0.8980	0.5845	0.5779	0.1208	0.1136	0.1135
1974	0.9956	1.0744	0.9073	0.1230	0.1248	0.1210
1975	1.1225	1.0578	0.9833	0.1259	0.1244	0.1227
1976	1.2294	1.0795	1.0110	1.2835	0.1243	0.1233
1977	1.2707	1.1625	1.1046	0.1293	0.1268	0.1255
1978	1.2587	1.2112	1.0825	0.1290	0.1279	0.1250
1979	1.3635	1.2403	1.0362	0.1314	0.1286	0.1239
1980	1.4079	1.1108	1.0632	0.1324	0.1256	0.1246
1981	1.4033	1.2330	0.9197	0.1323	0.1284	0.1213
1982	1.3300	0.8073	1.1843	0.1307	0.1187	0.1273
1983	1.3132	0.5693	1.2336	0.1303	0.1133	0.1285
Mean	1.2035	0.9771	0.9636	0.1278	0.1226	0.1223
σ	0.1936	0.2636	0.2298	0.0044	0.0060	0.0052

Notes: β_1 is obtained from $\hat{R}_T = \alpha_T + \beta_T \hat{R}_{mT} + \tilde{v}_T$

β_2 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{11} \beta_{iT} \tilde{R}_{mT_{i\ 5,1,15}} + \tilde{v}_T$

β_3 is obtained from $\hat{R}_T = \alpha_T + \sum_{i=1}^{4} \beta_{iT} \tilde{R}_{mT_{i\ 3,1}} + \tilde{v}_T$

$CAPM_1 = 0.1003 + \beta_1{*}(0.12312-0.1003)$

$CAPM_2 = 0.1003 + \beta_2{*}(0.12312-0.1003)$

$CAPM_3 = 0.1003 + \beta_3{*}(0.12312-0.1003)$

Where T is the interval length = 60 months;

$\tilde{R}_T$ is the observed return in period T of this firm;

$\tilde{R}_{mT}$ = observed return on 750 actuaries ordinary share index;

$\tilde{v}_t$ is the stochastic disturbance term.

TABLE 13. Cost of Capital Firm 3.

YEARS	β_1	β_2	β_3	$CAPM_1$	$CAPM_2$	$CAPM_3$
1973	0.7594	0.8293	0.6866	0.1178	0.1192	0.1159
1974	0.8560	1.0134	0.8809	0.1198	0.1234	0.1204
1975	0.7812	0.9678	0.5939	0.1181	0.1224	0.1138
1975	0.7267	1.0676	0.6121	0.1169	0.1247	0.1143
1976	0.7259	0.9479	0.5401	0.1169	0.1219	0.1126
1977	0.7626	1.1675	0.6805	0.1177	0.1267	0.1158
1978	0.7063	1.0933	0.6464	0.1164	0.1252	0.1150
1979	0.7379	1.4480	0.7894	0.1171	0.1333	0.1183
1980	0.7373	1.2056	1.2689	0.1171	0.1278	0.1292
1981	0.6234	0.8098	0.7312	0.1145	0.1188	0.1170
1982	0.5232	-0.0149	0.4641	0.1122	0.1000	0.1109
1983	0.5750	-0.8628	-0.0413	0.1134	0.0806	0.0994
Mean	0.7096	0.8060	0.6544	0.1165	0.1187	0.1152
σ	0.0926	0.6330	0.3005	0.0021	0.0144	0.0069

Notes: β_1 is obtained from $\tilde{R}_T = \alpha_T + \beta_T \tilde{R}_{mT} + \tilde{v}_T$

β_2 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{11} \beta_{iT} \tilde{R}_{mT_{t-5,t+5}} + \tilde{v}_T$

β_3 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{4} \beta_{iT} \tilde{R}_{mT_{t-3,t}} + \tilde{v}_T$

$CAPM_1 = 0.1003 + \beta_1 * (0.12312 - 0.1003)$

$CAPM_2 = 0.1003 + \beta_2 * (0.12312 - 0.1003)$

$CAPM_3 = 0.1003 + \beta_3 * (0.12312 - 0.1003)$

Where T is the interval length = 60 months;

$\tilde{R}_T$ is the observed return in period T of this firm;

$\tilde{R}_{mT}$ = observed return on 750 actuaries ordinary share index;

$\tilde{v}_t$ is the stochastic disturbance term.

TABLE 14. Cost of Capital Firm 4.

YEARS	β_1	β_2	β_3	$CAPM_1$	$CAPM_2$	$CAPM_3$
1972	0.8515	-0.1092	0.5897	0.1197	0.0978	0.1137
1973	0.6799	0.0285	0.4088	0.1158	0.1009	0.1096
1974	0.6895	0.2483	0.5572	0.1160	0.1059	0.1130
1975	0.8144	0.5026	0.6313	0.1189	0.1118	0.1147
1976	0.8480	0.7767	0.7683	0.1196	0.1180	0.1178
1977	0.8594	0.8737	0.8611	0.1199	0.1202	0.1199
1978	0.9314	0.8292	0.9321	0.1215	0.1192	0.1212
1979	0.8865	1.0265	0.8567	0.1205	0.1237	0.1198
1980	0.6678	1.0742	1.0968	0.1155	0.1248	0.1253
1981	0.8140	1.1185	1.3373	0.1189	0.1258	0.1308
1982	0.8078	0.8881	1.0489	0.1187	0.1206	0.1242
1983	0.8176	0.5110	0.8437	0.1190	0.1120	0.1195
Mean	0.8057	0.6470	0.8277	0.1187	0.1151	0.1192
σ	0.0841	0.4110	0.2596	0.0019	0.0094	0.0059

Notes: β_1 is obtained from $\tilde{R}_T = \alpha_T + \tilde{\beta}_T R_{mT} + \tilde{v}_T$

β_2 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{11} \beta_{iT} \tilde{R}_{mT_{t-5,t,t+5}} + \tilde{v}_T$

β_3 is obtained from $\tilde{R}_T = \alpha_T + \sum_{i=1}^{4} \beta_{iT} \tilde{R}_{mT_{t-3,t}} + \tilde{v}_T$

$CAPM_1 = 0.1003 + \beta_1^* (0.12312-0.1003)$

$CAPM_2 = 0.1003 + \beta_2^* (0.12312-0.1003)$

$CAPM_3 = 0.1003 + \beta_3^* (0.12312-0.1003)$

Where T is the interval length = 60 months;

$\tilde{R}_T$ is the observed return in period T of this firm;

$\tilde{R}_{mT}$ = observed return on 750 actuaries ordinary share index;

$\tilde{v}_t$ is the stochastic disturbance term.

TABLE 15. Cost of Capital Firm 5.

YEARS	β_1	β_2	β_3	$CAPM_1$	$CAPM_2$	$CAPM_3$
1972	0.1228	0.0199	0.2970	0.1031	0.1008	0.1071
1973	0.4914	0.2996	0.3959	0.1115	0.1071	0.1093
1974	0.4731	0.2968	0.6149	0.1111	0.1071	0.1143
1975	0.3708	0.5603	1.0091	0.1088	0.1131	0.1233
1976	0.5581	0.7943	1.0856	0.1130	0.1184	0.1251
1977	0.5394	0.7838	1.0062	0.1126	0.1182	0.1233
1978	0.4838	0.8312	1.0035	0.1113	0.1193	0.1232
1979	0.2569	0.4710	1.1747	0.1062	0.1110	0.1271
1980	0.5379	0.0811	0.4748	0.1126	0.1021	0.1111
1981	0.2595	0.5592	0.3708	0.1062	0.1131	0.1088
1982	0.3271	0.8584	1.4281	0.1078	0.1199	0.1329
1983	0.6429	2.8392	2.3117	0.1150	0.1651	0.1530
Mean	0.4220	0.7000	0.9310	0.1099	0.1163	0.1215
σ	0.1539	0.7320	0.5690	0.0035	0.0167	0.0130

Notes: β_1 is obtained from $\widehat{R}_T = \alpha_T + \beta_T \overline{R}_{mT} + \tilde{v}_T$

β_2 is obtained from $\widehat{R}_T = \alpha_T + \sum_{i=1}^{11} \beta_{iT} \widehat{R}_{mT_{t-5,t+5}} + \tilde{v}_T$

β_3 is obtained from $\widehat{R}_T = \alpha_T + \sum_{i=1}^{4} \beta_{iT} \widehat{R}_{mT_{t-3,t}} + \tilde{v}_T$

$CAPM_1 = 0.1003 + \beta_1 * (0.12312 - 0.1003)$

$CAPM_2 = 0.1003 + \beta_2 * (0.12312 - 0.1003)$

$CAPM_3 = 0.1003 + \beta_3 * (0.12312 - 0.1003)$

Where T is the interval length = 60 months;

$\tilde{R}_T$ is the observed return in period T of this firm;

$\tilde{R}_{mT}$ = observed return on 750 actuaries ordinary share index;

$\tilde{v}_t$ is the stochastic disturbance term.

From these tables we can see that, in terms of stability beta computed from the first method which does not take into account the leads or lags in the market return provides more consistent results. There is a possibility that thin trading may underestimate beta obtained using this method. However the cost of capital computed from CAPM does not change substantially from one method to another.

TABLE 16. Average Firms' Beta and Cost of Capital over Sample Period.

Firms' Beta	Standard Deviation of Beta	$CAPM_i$	σ_{CAPMi}
1.4203	0.1493	0.1327	0.0034
1.8385	0.2171	0.1422	0.0049
1.2035	0.1936	0.1278	0.0044
0.8906	0.1519	0.1206	0.0035
0.9973	0.0852	0.1231	0.0019
1.2669	0.1861	0.1292	0.0042
1.0941	0.1806	0.1253	0.0041
0.9898	0.3186	0.1229	0.0073
0.7678	0.1474	0.1178	0.0034
1.0797	0.1678	0.1249	0.0038
0.9560	0.3590	0.1221	0.0082
1.0195	0.0806	0.1236	0.0018
0.7415	0.1276	0.1172	0.0029
1.3249	0.2336	0.1305	0.0053
0.4706	0.1073	0.1110	0.0024
0.7096	0.0926	0.1165	0.0021
1.0876	0.2627	0.1251	0.0060
1.3507	0.2698	0.1311	0.0062
1.5600	0.2885	0.1359	0.0066
1.3016	0.2183	0.1300	0.0050
1.6140	0.4160	0.1371	0.0095
1.0060	0.4760	0.1233	0.1087
0.8990	0.1597	0.1208	0.0036
0.8624	0.3157	0.1200	0.0072
1.3044	0.1278	0.1301	0.0029

0.9738	0.2112	0.1225	0.0048
0.3151	0.0422	0.1075	0.0010
1.0244	0.1184	0.1237	0.0027
0.6083	0.2461	0.1142	0.0056
0.8600	0.5040	0.1199	0.0115
0.5406	0.2911	0.1126	0.0066
0.5928	0.1163	0.1138	0.0026
0.8332	0.2694	0.1193	0.0062
1.2594	0.0775	0.1290	0.0018
1.4363	0.2561	0.1331	0.0059
0.5005	0.0339	0.1117	0.0008
1.1337	0.2410	0.1262	0.0055
0.8056	0.0841	0.1187	0.0019
1.3764	0.1798	0.1317	0.0041
1.0135	0.0955	0.1234	0.0022
1.1486	0.3284	0.1265	0.0075
1.6813	0.1999	0.1387	0.0046
1.4560	0.2166	0.1335	0.0049
1.3233	0.1918	0.1305	0.0044
0.6854	0.2823	0.1159	0.0064
1.2633	0.3369	0.1291	0.0077
1.2238	0.2508	0.1282	0.0057
0.8410	0.4380	0.1195	0.0100
1.6737	0.2963	0.1385	0.0068
1.2620	0.3690	0.1291	0.0084
1.4867	0.1594	0.1342	0.0036
1.2372	0.1972	0.1285	0.0045
1.2494	0.2545	0.1288	0.0058
1.3155	0.3339	0.1303	0.0076
1.0706	0.2429	0.1247	0.0055
1.2053	0.2052	0.1278	0.0047
1.0551	0.0534	0.1244	0.0012
1.2311	0.2173	0.1284	0.0050
1.0975	0.2119	0.1253	0.0048

1.3407	0.1015	0.1309	0.0023
0.4220	0.1539	0.1099	0.0035
0.9960	0.4870	0.1230	0.0111
1.8629	0.2790	0.1428	0.0064
0.9854	0.1773	0.1228	0.0040
1.0152	0.1075	0.1235	0.0024
0.7000	0.3560	0.1163	0.0081
1.0937	0.2142	0.1253	0.0049
0.7559	0.1255	0.1175	0.0029
1.3045	0.3340	0.1301	0.0076
1.3055	0.2261	0.1301	0.0052
1.1475	0.2096	0.1265	0.0048
0.5178	0.1253	0.1121	0.0029
1.1098	0.2675	0.1256	0.0061
0.9643	0.2819	0.1223	0.0064
1.8290	0.1224	0.1420	0.0028
1.3765	0.0661	0.1317	0.0015
1.7187	0.1086	0.1395	0.0025
1.0902	0.1417	0.1252	0.0032
1.0288	0.1227	0.1238	0.0028
0.6836	0.1770	0.1159	0.0040
0.9646	0.1862	0.1223	0.0042
0.9834	0.1217	0.1227	0.0028
1.1310	0.3480	0.1261	0.0079
1.0238	0.2544	0.1237	0.0058
1.1308	0.1997	0.1261	0.0046
1.7521	0.3103	0.1403	0.0071
0.8564	0.1200	0.1198	0.0027
1.3915	0.1810	0.1321	0.0041
1.1830	0.4010	0.1273	0.0091
1.1964	0.1166	0.1276	0.0027
1.1311	0.0995	0.1261	0.0023
0.7947	0.0761	0.1184	0.0017
1.3484	0.1724	0.1311	0.0039

1.5677	0.2161	0.1361	0.0049
1.2102	0.2840	0.1279	0.0065
0.8860	0.1986	0.1205	0.0045
0.9683	0.2162	0.1224	0.0049
1.7926	0.1671	0.1412	0.0038
1.0449	0.1836	0.1241	0.0042
0.9906	0.2974	0.1229	0.0068
1.3879	0.1283	0.1320	0.0029
1.1882	0.1130	0.1274	0.0026
1.4916	0.0804	0.1343	0.0018
1.0994	0.1971	0.1254	0.0045
1.1720	0.1482	0.1270	0.0034
1.0474	0.1883	0.1242	0.0043
1.3285	0.1926	0.1306	0.0044
1.1480	0.2152	0.1265	0.0049
1.1357	0.1634	0.1262	0.0037

Notes: β_i is obtained from: $\widetilde{R}_{i,T} = \alpha_i + \beta_i \hat{\tilde{R}}_{mT} + \hat{\tilde{v}}_{iT}$;

$CAPM_i = 0.1003 + \beta_i * (0.12312 - 0.1003)$;

σ_{CAPMi} Standard of deviation of CAPM over 12 years period;

There were 23 companies which did not have the monthly returns started only in 1970, therefore, we could not compute beta for the earlier years. Instead, we assumed the average for the next three years to approximate beta for 1972-1974 for these companies.

APPENDIX II: SAMPLE OF COMPANIES

TABLE II.7. LIST OF FIRMS

COMPANY NAME	INDUSTRY	PUBLICATION DATE
AARONSON BROS. PLC	17	30/09
ALLIED TEXTILE COMPANIES PLC	61	30/09
APPLEYARD GROUP PLC	42	31/12
ARMSTRONG EQUIPMENT PLC	41	02/07
ASSOCIATED FISHERIES PLC	49	30/09
ASSOCIATED PAPER INDUSTRIES	54	02/10
AVON RUBBER PLC	41	02/10
BAILEY (C.H.) PLC	29	26/03
BARKER AND DOBSON GROUP PLC	58	31/12
BARRATT DEVELOPMENTS PLC	18	30/06
BARROW HEPBURN GROUP PLC	73	31/12
BASS PLC	45	30/09
BATH & PORTLAND GROUP PLC	11	31/10
BEATSON CLARK PLC	54	31/12
BEMROSE CORPORATION PLC	54	31/12
BENFORD CONCRETE MACHINERY PLC	22	31/12
BODDINGTON BREWERIES PLC	45	31/12
BOLTON TEXTILE MILL CO. PLC (THE)	59	30/04
BOULTON (WILLIAM) GROUP	22	30/06
BRITISH DREDGING PLC	14	31/12
BRITISH MOHAIR HOLDINGS PLC	61	31/12
BRITISH SYPHON INDUSTRIES PLC	27	31/12
BROWN (MATTHEW) PLC	45	01/10
BRYANT HOLDINGS PLC	18	31/05
CARR (JOHN)(DONCASTER) PLC	17	30/09
CLAY (RICHARD) PLC	53	31/12
COHEN (A.) & CO. PLC	32	31/12
CONCENTRIC PLC	27	30/09

COWIE (T.) PLC	42	30/09
CREST NICHOLSON PLC	73	31/10
CROWTHER (JOHN) GROUP PLC	61	31/12
DAVENPORTS' BREWERY (HOLDINGS) PLC	45	01/10
DESOUTTER BROTHERS (HOLDINGS) PLC	28	31/12
DEVENISH (J.A.) PLC	45	30/09
DOWDING & MILL PLC	19	30/06
DUBILIER PLC	35	02/10
EIS GROUP PLC	27	31/12
E.R.F. (HOLDINGS) PLC	43	31/03
EAST LANCASHIRE PAPER GROUP PLC	54	31/12
ELECO HOLDINGS PLC	11	30/06
ELECTRONIC MACHINE CO PLC	35	30/09
ERITH PLC	13	31/12
EXPAMET INTERNATIONAL PLC	14	31/12
FISHER (JAMES) & SONS PLC	71	31/12
FOLKES (JOHN) HEFO PLC	27	31/12
FOTHERGILL & HARVEY PLC	11	31/12
GLEESON (M.J.) GROUP PLC	18	30/06
GOMME HOLDINGS PLC	38	29/07
GRAIG SHIPPING PLC	71	31/03
GRAMPIAN HOLDINGS PLC	73	31/12
GRANADA GROUP PLC	36	01/10
GREENALL WHITLEY PLC	45	30/09
GROUP LOTUS CAR COMPANIES PLC	43	30/12
HARDYS & HANSON PLC	45	30/09
HARRISON (T.C.) PLC	42	31/12
HIGSON BREWERY PLC	45	30/09
I.D.C. GROUP PLC	18	31/10
JACKSON (J. & H.B.) PLC	34	30/09
JONES STROUD (HOLDINGS) PLC	19	31/03
KELSEY INDUSTRIES PLC	73	30/09
LAKE & ELLIOT PLC	21	30/09
LEC REFRIGERATION PLC	39	31/12

LISTER & CO. PLC	62	26/03
LONDON & NORTHERN GROUP PLC	73	31/12
MACARTHYS PHARMACEUTICALS PLC	67	30/04
MANCHESTER SHIP CANAL CO. (THE)	72	31/12
MANGANESE BRONZE HOLDINGS PLC	32	31/07
METAMEC JENTIQUE PLC	38	30/06
MILLER (STANLEY) HOLDINGS PLC	18	31/12
MORLAND & CO. PLC	45	30/09
MUIRHEAD PLC	19	30/09
NEEPSEND PLC	27	31/03
NEWMAN INDUSTRIES PLC	11	31/12
NOTTINGHAM MANUFG. CO. PLC (THE)	59	31/12
NU-SWIFT INDUSTRIES PLC	76	31/12
NURDIN & PEACOCK PLC	51	31/12
OFFICE & ELECTRONIC MACHINES PLC	69	31/12
PARKER KNOLL PLC	38	31/07
PEARCE (C.H.) & SONS PLC	18	31/05
PLAXTON'S (GB) PLC	43	02/10
PRATT (F.) ENGINEERING CORPN PLC	27	31/10
REARDON SMITH LINE PLC	71	31/03
REDFEARN NATIONAL GLASS PLC	54	02/10
ROBERTS, ADLARD PLC	13	31/12
SAMUELSON GROUP PLC	48	31/03
SCHOLES (GEORGE H.) PLC	19	30/06
SCOTT & ROBERTSON PLC	54	31/12
SHARPE & FISHER PLC	13	31/12
SIDLAW GROUP PLC	73	30/09
SIMPSON (S.) PLC	59	31/07
SOUND DIFFUSION PLC	19	31/12
STEWART PLASTICS PLC	66	30/04
STOTHERT & PITT PLC	23	30/06
SUNLIGHT SERVICE GROUP PLC	74	31/12
TELEFUSION PLC	36	30/04
TILBURY GROUP PLC	18	31/12

TRAVIS & ARNOLD PLC	13	31/12
ULSTER TELEVISION LTD	48	31/07
UNITED NEWSPAPERS PLC	52	31/12
VAUX BREWERIES PLC	45	01/10
WADKIN PLC	28	31/12
WAGON INDUSTRIAL HOLDINGS PLC	23	31/03
WATSON & PHILIP PLC	51	28/10
WESTLAND PLC	27	30/09
WILSON (CONNOLLY) HOLDINGS PLC	18	31/12
WOLSELEY-HUGHES PLC	13	31/07
WOLSTENHOLME RINK PLC	68	31/12
WOLVERHAMPTON & DUDLEY BREWERIES PLC	45	30/09
WOOD (S.W.) GROUP PLC	32	31/03

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